CRS-300

1:10 Redundancy Switch
Installation and Operation Manual

Part Number MN/CRS300.IOM
Revision 4

CRS-300

Comtech EF Data is an ISO 9001
Registered Company.

1:10 Redundancy Switch
Installation and Operation Manual

Part Number MN/CRS300.IOM
Revision 4
December 14, 2004

Copyright © Comtech EF Data, 2000. All rights reserved. Printed in the USA.
Comtech EF Data, 2114 West 7th Street, Tempe, Arizona 85281 USA, (480) 333-2200, FAX: (480) 333-2161

CUSTOMER SUPPORT

Contact the Comtech EF Data Customer Support Department for:

- Product support or training
- Information on upgrading or returning a product
- Reporting comments or suggestions concerning manuals

Contact Customer Support using any of the following methods:

Mail: Comtech EF Data
Customer Support Department
2114 West 7th Street
Tempe, Arizona 85281 USA

Email: service@comtechefdata.com

Internet: www.comtechefdata.com

Phone: 480.333.2200 (Main Comtech EF Data Number)
480.333.4357 (Customer Support Desk)

Fax: 480.333.2161

To return a Comtech EF Data product (in-warranty and out-of-warranty) for repair or replacement:

1. Request a Return Material Authorization (RMA) number from the Comtech EF Data Customer Support Department.

2. Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.

3. To ensure that the product is not damaged during shipping, pack the product in its original shipping carton/packaging.

4. Ship the product back to Comtech EF Data. (Shipping charges should be prepaid.)

For more information regarding the warranty policies, see Warranty Policy, p. xi.

Table of Contents

CHAPTER 1. INTRODUCTION 1–1

1.1 Overview 1–2
1.1.1 Compatibility 1–4
1.1.2 Redundancy System-Level Block 1–4

1.2 Description of Assemblies 1–6
1.2.1 CRS-300 Description 1–6
1.2.2 Optional CRS-280 IF Switch Description 1–10
1.2.3 Optional CRS-350 ESC (Engineering Service Channel) Switch 1–11

1.3 Specifications 1–12

CHAPTER 2. INSTALLATION 2–1

2.1 Unpacking and Inspection 2–1

2.2 System Requirements 2–1
2.2.1 Provide Airflow 2–2
2.2.2 Rack Mounting Instructions 2–2

2.3 Installation Details 2–2

2.4 Connecting the Cables 2–4
2.4.1 Physical Cable Requirements 2–4
2.4.2 Modem Data Cables 2–5
2.4.3 External Data Connection 2–7
2.4.4 Control Cable for Optional CRS-280 and CRS-350 2–8
2.4.5 CRS-350 to Modem Cables 2–10
2.4.6 CRS-350 External User Interface 2–11

2.5 Applying Power to the Switch 2–11

2.6 Configuring the Switch 2–12
2.6.1 Activate the Desired Traffic Modems 2–12
2.6.2 Verify Remote Communications to Each Active Modem 2–13

2.7 Configuring the IF Carriers 2–13
2.7.1 Configuring and Cabling for a Single Transponder 2–14
2.7.2 Configuring and Cabling for Multiple Transponder 2–14
2.7.3 Manual Mode Operation 2–17
2.7.4 Automatic Mode Operation 2–17
2.7.5 Backup Holdoff Operation 2–17
2.7.6 Restore Holdoff Operation 2–18
2.7.7 Alarm Masking 2–18

2.8 CRS-300 Connector Pin-Outs 2–19

2.9 TMI Module Configurations 2–26

CHAPTER 3. FRONT PANEL OPERATION 3–1

3.1 Front Panel Display 3–1

3.2 Front Panel Keys 3–2

3.3 LED Indicators 3–2

3.4 Menu Tree 3–3
3.4.1 Opening Screen 3–5
3.4.2 Select 3–5
3.4.3 CONFIG 3–6
3.4.4 INFO (Information) 3–12
3.4.5 Monitor 3–14
3.4.6 Store/LD (Store or Load Configuration) 3–20
3.4.7 UTIL (Utilty) 3–22

3.5 Flash Upgrading 3–24

Appendix A. REMOTE CONTROL A–1

A.1 EIA-485 ..... A–1

A.2 EIA-232 ..... A–2

A.3 Basic Protocol A–2

A.4 Packet Structure A–3
A.4.1 Controller-to-Target A–3
A.4.2 Target-to-Controller A–3
A.4.3 Start Of Packet A–3
A.4.4 Address A–4
A.4.5 Instruction Code A–5
A.4.6 Instruction Code Qualifier A–5
A.4.7 Message Arguments A–6
A.4.8 End Of Packet A–6

A.5 Remote Commands ..... A -7

APPENDIX B. CABLE DRAWINGS B–1

APPENDIX C. ADDRESSING SCHEME C–1

C.1 Introduction C–1

C.2 Switch Address C–1

C.3 Modem & Transceiver Addresses C–2
C.3.1 Setting Up Modems C–5
C.3.2 Setting Up Transceivers C–5
C.3.3 M&C Application C–6

Figures

Figure 1-1. The Comtech EF Data 1:10 Redundancy Switch System 1–1
Figure 1-2. Redundancy System-Level Block Diagram 1–5
Figure 1-3. CRS-300 Front Panel 1–6
Figure 1-4. CRS-300 Rear Panel 1–7
Figure 1-5. CRS-230 System Controller (AS/0377) 1–8
Figure 1-6. CRS-240 Power Supply (AS/0376) 1–8
Figure 1-7. CRS-310 RMI (PL/9579) 1–8
Figure 1-8. CRS-320 TMI (PL/9581-1) 1–8
Figure 1-9. CRS-330 TMI (PL/9033-1) 1–9
Figure 1-10. CRS-340 TMI (PL/9371-1) 1–9
Figure 1-11. CRS-370 TMI (PL/9034-1) 1–9
Figure 1-12. Optional CRS-280 IF Switch 1–10
Figure 1-13. CRS-350 ESC Switch 1–11
Figure 1-14. CRS-355 UDI 1–11
Figure 1-15. CRS-300 Dimensional Envelope 1–15
Figure 1-16. CRS-280 Dimensional Envelope 1–16
Figure 1-17. CRS-350 Dimensional Envelope 1–17
Figure 2-1. Typical Rack Mounting Configuration 2–3
Figure 2-2. Cabling Example for CRS-300 to CDM-600 Modems 2–6
Figure 2-3. Control Cable Connection for CRS-280 2–8
Figure 2-4. Control Cable Connection for CRS-350 and CRS-280 2–9
Figure 2-5. Cabling Example for CRS-350 ESC to CDM-600 Modems 2–10
Figure 2-6. Cabling Example CRS-280 to CDM-600 Modems 2–16
Figure 2-7. CRS-370 HSSI to LVDS Module 2–26
Figure 3-1. Principle Menu Trees 3–4
Figure B-1. PC 9-Pin Serial Port to CRS-300 EIA-232 Remote Control Port B–1
Figure B-2. HSSI Data Cable B–2
Figure B-3. EIA-530 to EIA-422/449 DCE Conversion Cable B–3
Figure B-4. EIA-530 to V.35 DCE Conversion Cable B–4
Figure B-5 Switch to Modem Cable (RS232/422/V.35/LVDS) 25-Pin B–5
Figure B-6. Switch to Modem Cable (G.703) 15-Pin 10–5

Tables

Table 1-1. CRS-300 Specifications 1–12
Table 1-2. CRS-280 Specifications 1–14
Table 1-3. CRS-350 Specifications 1–14
Table 2-1. CRS-300 to Modem Data Connections 2–5
Table 2-2. CRS-280 IF Switch Connections 2–15
Table 2-3. System Alarms Connectors 2–19
Table 2-4. IF Switch Control Connector, 25-Pin 2–20
Table 2-5. Remote Control Connector, 9-Pin 2–21
Table 2-6. Data Connector 2–22
Table 2-7. Balanced G.703 Interface Connector Pin Assignements 2–23
Table 2-8. Data Connector (G.703 Unbalanced) 2–24
Table 2-9. HSSI Pinout (J1) 50-Pin 2–24
Table 2-10. 8 kHz-IDR ESC Interface Connector Pin Assignements 2–25
Table 2-11. CRS-370 J2 Jumper Settings 2–26
Table 3-1. Switch LED Indicators 3–3
Table 3-2. Transmit and Receive Traffic Modem LED Indicator 3–3

NOTES:

ABOUT THIS MANUAL

This manual provides installation and operation information for the Comtech EF Data CRS-300 1:10 Redundancy Switch. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the CRS-300 1:10 Redundancy Switch.

RELATED DOCUMENTS

Comtech EF Data CDM-570 Satellite Modem Installation and Operation Manual

Comtech EF Data CDM-570L Satellite Modem Installation and Operation Manual

Comtech EF Data CDM-600 Satellite Modem Installation and Operation Manual

Comtech EF Data CDM-600L Satellite Modem Installation and Operation Manual

CONVENTIONS AND REFERENCES

CAUTIONS AND WARNINGS

Indicates information critical for proper equipment function.

Indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. CAUTION may also be used to indicate other unsafe practices or risks of property damage.

Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

METRIC CONVERSION

Metric conversion information is located on the inside back cover of this manual. This information is provided to assist the operator in cross-referencing English to Metric conversions.

RECOMMENDED STANDARD DESIGNATIONS

Recommended Standard (RS) Designations have been superseded by the new designation of the Electronic Industries Association (EIA). References to the old designations are shown only when depicting actual text displayed on the screen of the unit (RS-232, RS-485, etc.). All other references in the manual will be shown with the EIA designations (EIA-232, EIA-485, etc.) only.

TRADEMARKS

All product names mentioned in this manual may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

REPORTING COMMENTS OR SUGGESTIONS CONCERNING THIS MANUAL

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the Comtech EF Data Customer Support Department.

OVERVIEW OF CHANGES TO REVISION 4:

Appendix C: Added Addressing Scheme Information

Added information for the CDM-570 and CDM-570L Satellite Modems.

EMC COMPLIANCE

This is a Class A product. In a domestic environment, it may cause radio interference that requires the user to take adequate protection measures.

EN55022 - 1997 COMPLIANCE

This equipment meets the radio disturbance characteristic specifications for information technology equipment as defined in EN55022.

EN55024 - 1998 COMPLIANCE

This equipment meets the electromagnetic compatibility/Information technology equipment – Immunity characteristics – Limits and methods of measurement per EN55024:1998.

FEDERAL COMMUNICATIONS COMMISSION (FCC)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.

Note: To ensure compliance, properly shielded cables for DATA I/O shall be used. More specifically, these cables shall be shielded from end to end, ensuring a continuous shield.

SAFETY COMPLIANCE

EN 60950

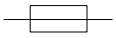
Applicable testing is routinely performed as a condition of manufacturing on all units to ensure compliance with safety requirements of EN60950.This equipment meets the Safety of Information Technology Equipment specification as defined in EN60950.

LOW VOLTAGE DIRECTIVE (LVD)

The following information is applicable for the European Low Voltage Directive (EN60950):

<HAR>	Type of power cord required for use in the European Community.
	CAUTION: Double-pole/Neutral Fusing. ACHTUNG: Zweipolige bzw. Neutralleiter-Sicherung.

International Symbols:

Symbol	Definition
	Alternating Current.
	Fuse.

Symbol	Definition
	Protective Earth.
	Chassis Ground.

Note: For additional symbols, refer to "Cautions" listed earlier in this preface.

WARRANTY POLICY

This Comtech EF Data product is warranted against defects in material and workmanship for a period of two years from the date of shipment. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective.

For equipment under warranty, the customer is responsible for freight to Comtech EF Data and all related custom, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges only for return of the equipment from the factory to the customer.

Comtech EF Data will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EF Data.

LIMITATIONS OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper installation or maintenance, abuse, unauthorized modification, or operation outside of environmental specifications for the product, or, for damages that occur due to improper repackaging of equipment for return to Comtech EF Data.

No other warranty is expressed or implied. Comtech EF Data specifically disclaims the implied warranties of merchantability and fitness for particular purpose.

EXCLUSIVE REMEDIES

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EF Data shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

DISCLAIMER

Comtech EF Data has reviewed this manual thoroughly in order that it will be an easy-to-use guide to your equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EF Data reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

If you have any questions regarding the equipment or the information in this manual, please contact the Comtech EF Data Customer Support Department.

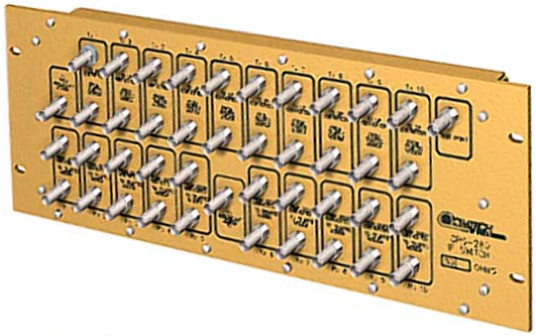
NOTES:

Chapter 1. Introduction

This chapter provides an overview, description and specifications for the CRS-300 1:10 Redundancy Switch (Figure 1-1) and optional system components.

CRS-300 1:10 Redundancy Switch

Optional CRS-280 IF Switch



Optional CRS-350 ESC (Engineering Service Channel) Switch

Figure 1-1. The Comtech EF Data 1:10 Redundancy Switch System

1.1 OVERVIEW

The CRS-300 1:10 Redundancy Switch provides fully automatic protection of traffic circuits in the case of equipment failure, and is intended for hub applications. It was developed for use with the Comtech EF Data CDM-600 and CDM-600L modems, and has been further developed to provide control for the CDM-570 and CDM-570L modems. It is an extension of the Comtech EF Data CRS-200 Redundancy Switch, which was developed for the CDM-500 series modems.

The Switch is capable of controlling four different modem models, but it is important to note that only one model type may be connected as a switch system. In simple terms, the redundant modem has to be capable on doing everything that a traffic modem might be set up to do. This is important also when considering options that may be installed in the modems.

Where protection of the IDR overhead signals (backward alarms, audio ESC, data ESC, etc) is desired, the CRS-350 module may be added.

If all Modems within a group are connected to the same up/down-converter, no external IF switching is required. However, where operation with more than one up/down-converter is required, the user may add the CRS-280 IF Switch, which permits connection to as many converters as there are Traffic Modems.

The CRS-300 incorporates the following key reliability features:

- Twin, independent, AC power supplies
- Primary traffic paths are maintained, error-free, when AC power is removed.
- A Traffic Modem Interface can be completely removed from the CRS-300, with its cables still attached, and traffic is not interrupted.
- Traffic Modem Interfaces (TMI) and the Redundant Modem Interface (RMI) can be replaced without disturbing other traffic circuits.

The CRS-300 supports all of the interface types available on the modems, which include EIA422/530, V.35, Sync EIA-232, G.703 balanced or unbalanced, LVDS and HSSI.

Note: Unlike many other products of this type, electrical interface types may be mixed within the same redundancy group.

When operating with a single up/down converter, the system comprises a maximum of 10 Traffic Modems, a Redundant Modem, and the CRS-300 Redundancy Switch. All IF inputs and outputs are passively split and combined. The Redundant Modem is in remote control mode, and the Traffic Modems may be in local or remote mode. All of the modems are connected to the CRS-300 Protection Switch via a single 25-pin cable, which connects data, alarms, and an EIA-232 link. The EIA-232 link provides the connection whereby the CRS-300 communicates with each modem. The Switch reads and stores each modem's configuration. One modem is bridged by the Redundant. The Switch sends the bridged modem configuration to the Redundant Modem.

IF switching is distributed - each Modem has an internal RF relay, which is normally under the control of the Modem's internal software. However, a direct hardware connection over-rides the processor setting, and turns the carrier off. All the Tx outputs of the modems are connected to a passive IF combiner, and the IF outputs from a Traffic or Redundant Modem can be enabled or disabled via a hardware command from the CRS-300. They receive IF for all of the Traffic Modems, and the Redundant Modem are fed with identical signals from a passive IF distribution system. In this way, the Redundant Modem can demodulate any of the input carriers going to the Traffic Modems.

The data and clock signals, to and from a Traffic Modem, are routed through a Traffic Modem Interface (TMI), via a set of relays. This is arranged so that the de-energized (un-powered) state connects the data signals directly through to the Traffic Modem. If the power supplies to the system are lost, or if a TMI carrying traffic is removed, no interruption of the traffic will take place. It should also be noted that in normal circumstances, where the Redundant Modem is not in service, no data is carried through the CRS-300 backplane - all data is routed via the TMI.

A key feature of the CRS-300 architecture is its ability to let the Redundant Modem 'bridge' a Traffic Modem. A copy of the data and clock signals feeding a particular Modem can be selectively routed to the Redundant Modem, and the RX IF can be tuned to receive any selected carrier. This has the advantage that no external test equipment is needed to determine the health of the Redundant Modem - live traffic is used at all times to verify performance.

The CRS-300 is modular in construction. All replaceable modules insert into slots in the rear. This includes: the Controller, PSUs, TMIs and the RMI. Power consumption is below 30 watts for a fully populated Switch, and hence no fan cooling is required.

Connection to the Traffic Modems and the Redundant Modem is remarkably simple. In the case of the multi-protocol interface, a single cable is required for each modem, which carries all data signals, alarm information, and remote control interface: EIA-232. If the G.703 interfaces are used, one additional cable is required. This simplifies rack cabling, and reduces the number of potential failure points.

1.1.1 COMPATIBILITY

The Switch is designed to operate with the:

- CDM-600 Satellite Modem
- CDM-600L Satellite Modem
- CDM-570 (when available)
- CDM-570L (firmware version 1.3.1 and subsequent)

Note: The Switch is capable of controlling four different modem models, but only one model type may be connected as a switch system. Example, the redundant modem has to be capable of doing everything that a traffic modem might be set up to do. This is important also when considering hardware or FAST options that may be installed in the traffic modems.

1.1.2 REDUNDANCY SYSTEM-LEVEL BLOCK

Figure 1-2 shows the system-level block diagram of the CRS-300 1:10 Redundancy Switch including the optional CRS-280 IF Switch and CRS-350 ESC Switch.

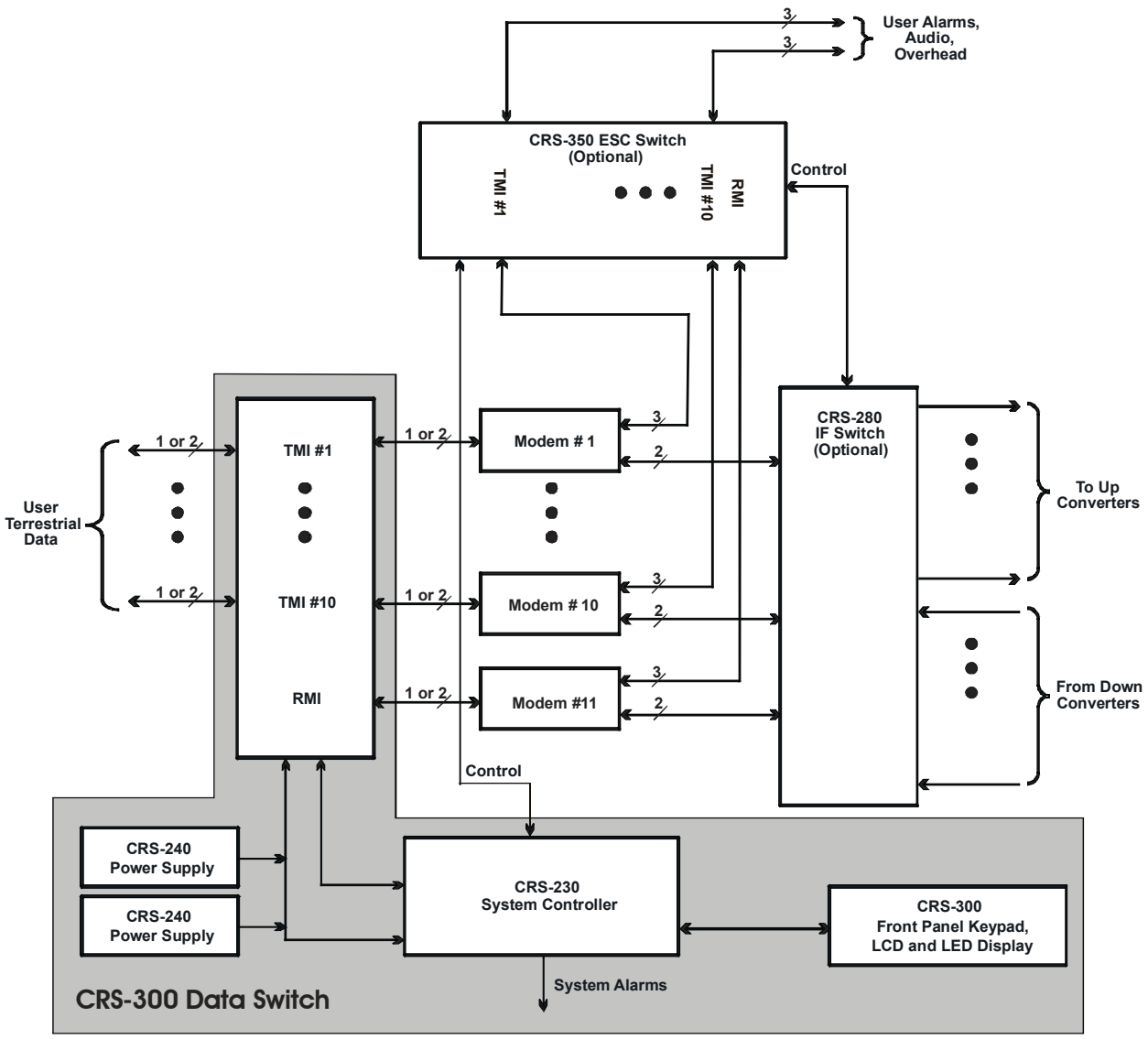


Figure 1-2. Redundancy System-Level Block Diagram

1.2 DESCRIPTION OF ASSEMBLIES

1.2.1 CRS-300 DESCRIPTION

FRONT PANEL - Figure 1-3 is an illustration of the front panel. The CRS-300 is constructed as a 4U high rack-mounting chassis that can be freestanding, if desired. It is provided with rack handles at the front for easy removal from and placement into a rack.

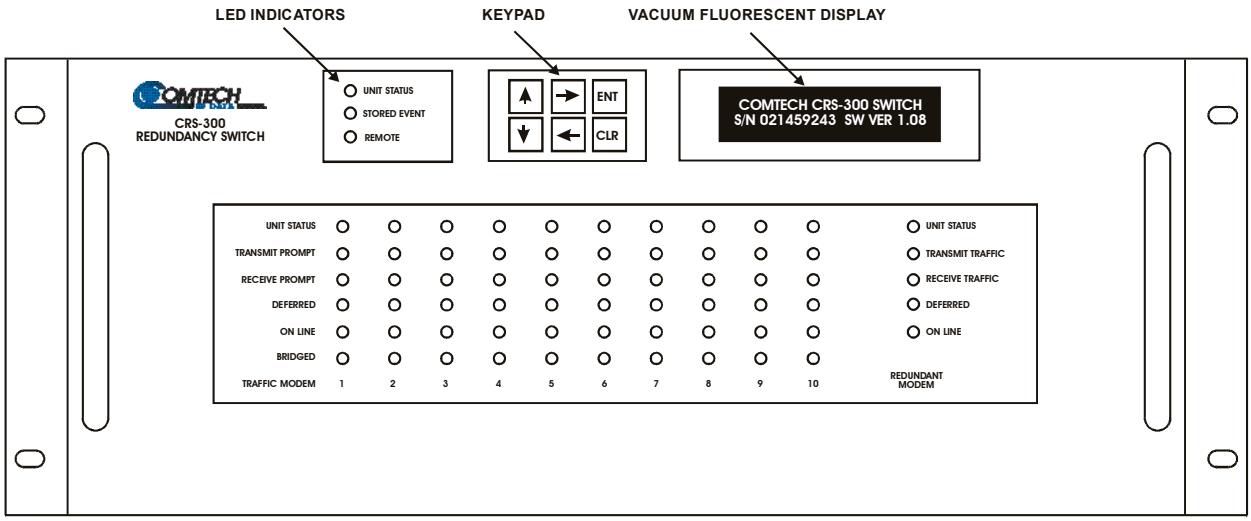


Figure 1-3. CRS-300 Front Panel

REAR PANEL – Figure 1-4 shows a typical configuration for the back panel of the CRS-300 where there is a mix of Traffic Modem Interface (TMI) cards. Depending on the user requirements, the CRS-300 can use any or all of the different TMI cards simultaneously. This is possible because the RMI has the capability for all of the different TMIs.

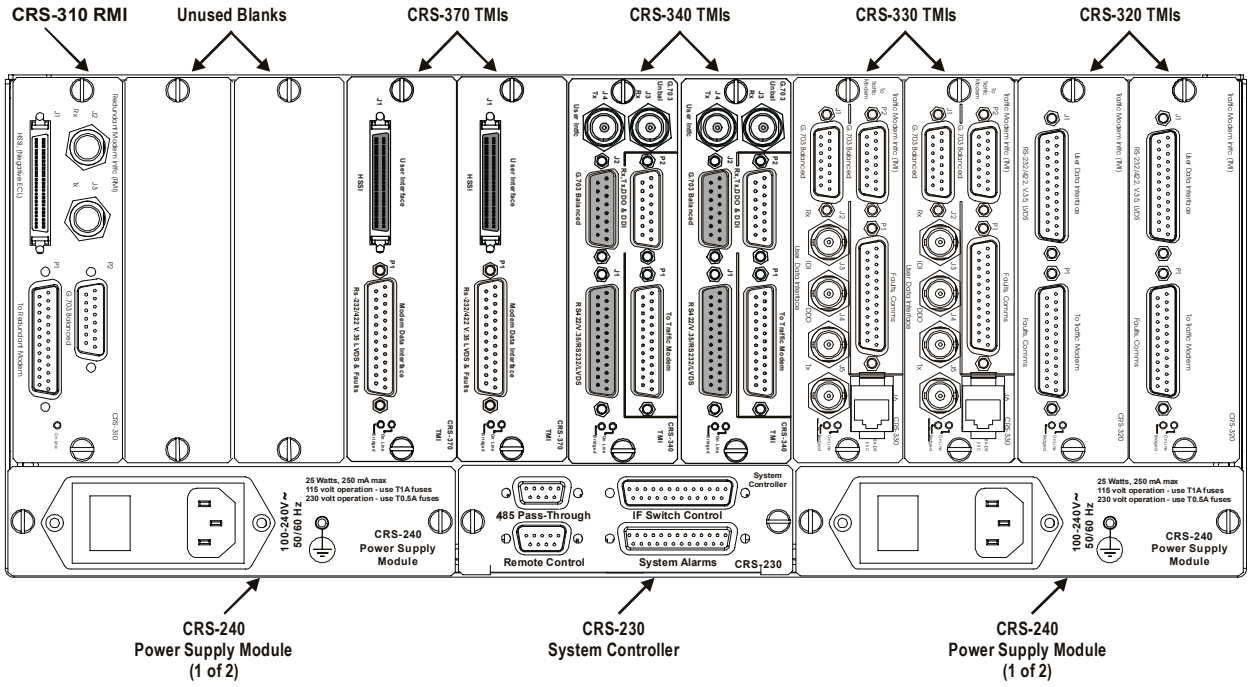


Figure 1-4. CRS-300 Rear Panel

SUBASSEMBLY PANEL DETAILS – Figure 1-5 through Figure 1-11 gives further details of the sub-assemblies for the CRS-300.

Figure 1-5. CRS-230 System Controller (AS/0377)

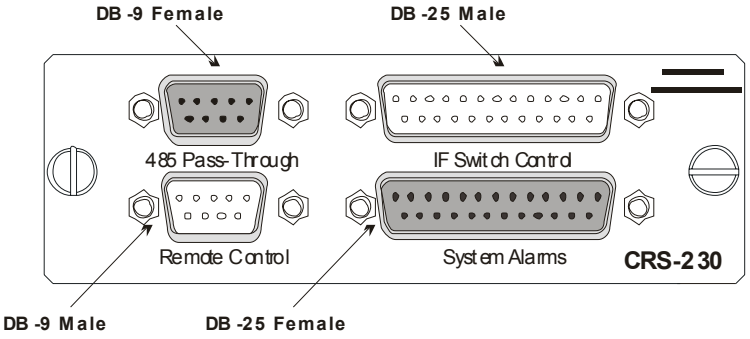


Figure 1-6. CRS-240 Power Supply (AS/0376)

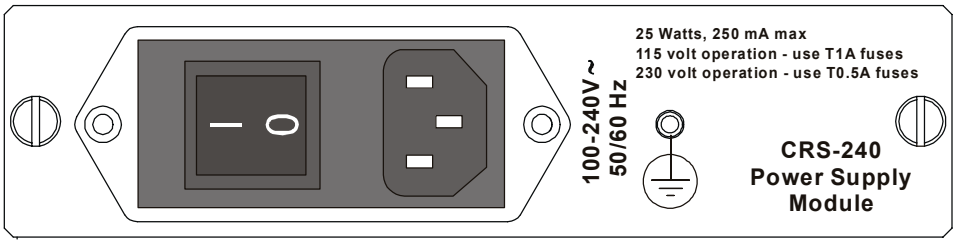


Figure 1-7. CRS-310 RMI (PL/9579)

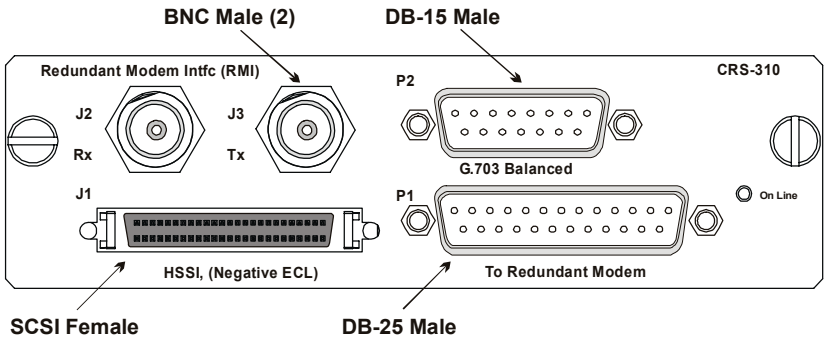


Figure 1-8. CRS-320 TMI (PL/9581-1)

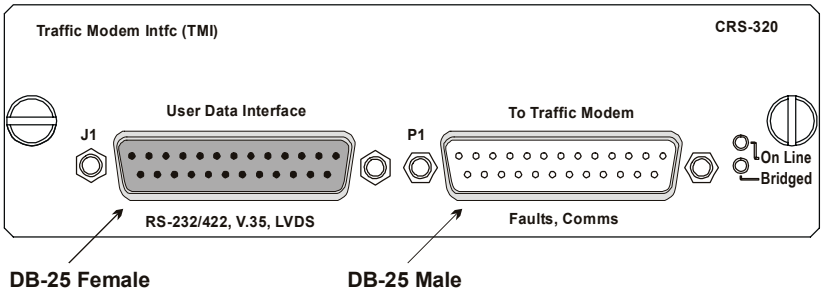


Figure 1-9.
CRS-330 TMI
(PL/9033-1)

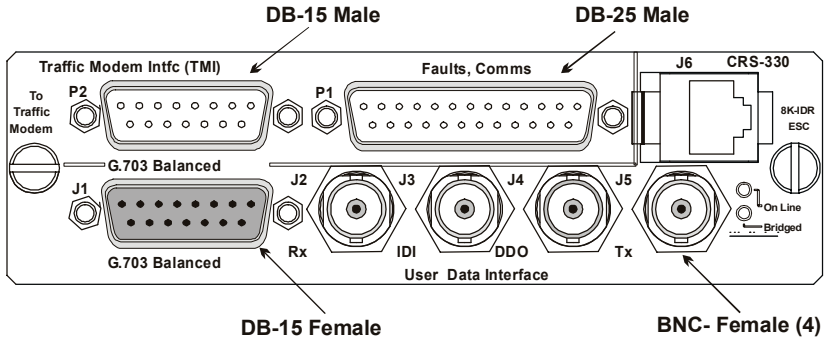


Figure 1-10.
CRS-340 TMI
(PL/9371-1)

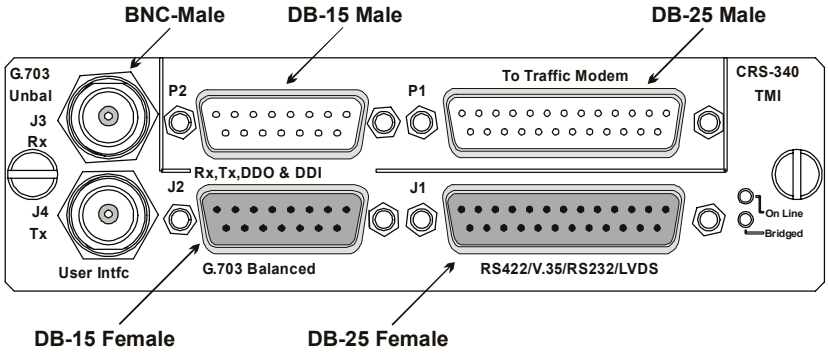
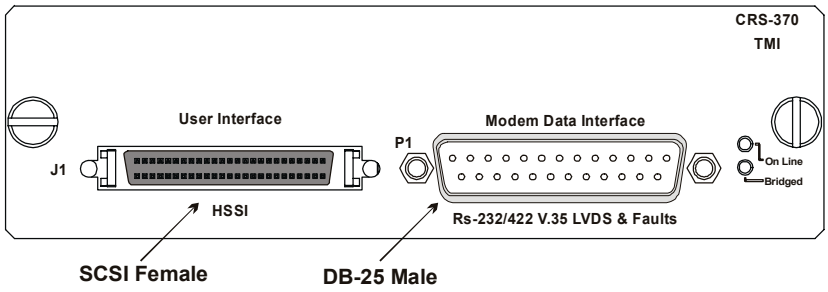


Figure 1-11.
CRS-370 TMI
(PL/9034-1)



1.2.2 OPTIONAL CRS-280 IF SWITCH DESCRIPTION

The CRS-280 is constructed as a 4U high rack-mounting chassis that is intended to be mounted to the back or top of a 19-inch deep rack. Figure 1-12 is an illustration of the front panel. It contains the connections for all 11 modems' receive and transmit IF cables. The back of the CRS-280 contains a 25-pin D subminiature type female connector for monitor and control functions from the CRS-300 or CRS-350.

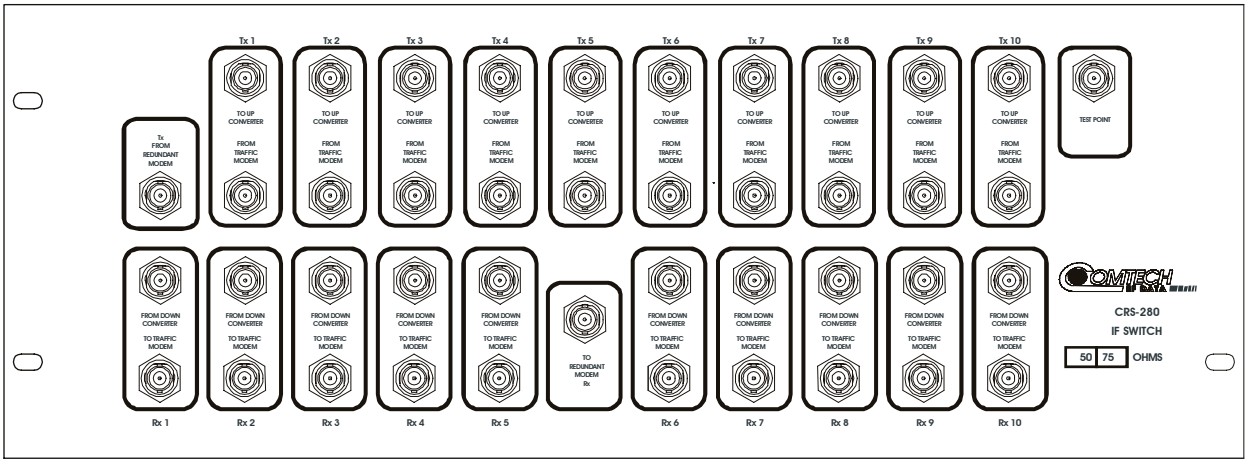


Figure 1-12. Optional CRS-280 IF Switch

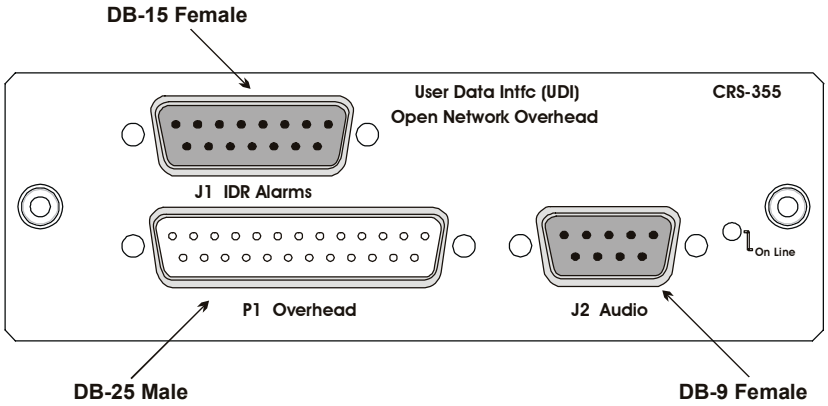
1.2.3 OPTIONAL CRS-350 ESC (ENGINEERING SERVICE CHANNEL) SWITCH DESCRIPTION

The CRS-350 is constructed as a 3U high rack-mounting chassis that is for mounting to the back of a 19-inch rack. Figure 1-13 shows the user interface side of the CRS-350 ESC Switch. Here the user has access to the Audio, Overhead and IRD connectors. The back of the CRS-350 contains the same three connectors that would connect to each of the three connectors on each of the modems.

Figure 1-13. CRS-350 ESC Switch

SUBASSEMBLY PANEL DETAILS –Figure 1-14 gives further details of the subassembly for the CRS-350.

Figure 1-14. CRS-355 UDI



1.3 SPECIFICATIONS

Table 1-1. CRS-300 Specifications

Characteristic	Requirement
AC Prime Power	Two independent inputs, 90 to 264 VAC; 50/60 Hz; at 25 Watts
Size/Weight	
Data Switch/Control Unit	4U 19W x 20.1D, Rack Mount (4U 48.26 W x 51.054D cm) < 20 pounds (< 9.07 kg)
IF Switch Unit	4U 19 W x ~4.5D inch, Rack Mount (4U 48.26 W x 11.43 D cm) < 10 lbs (<4.54 kg)
Environmental	
Temperature	0 to +40° C (32 to 104° F) Operating 50 to +100° C (122 to 212° F) Storage
Humidity	95% at +40° C (104° F), Non-condensing
EMC And Safety	EN 55022 Class B emissions EN 50082-1 immunity EN 60950 Safety FCC Part 15 Class B
Type	1:N redundancy Switch system, N=10 max, bridging architecture.
	C161 control processor
Operating Modes	Fully automatic or manual
	Force Traffic Modem to Redundant Modem
	Force Redundant Modem to bridge Traffic Modem
	Remove selected Traffic Modem from control
	Programmable hold-off to backup and hold-off to restore from 2 to 99 seconds
Redundant Modem signal source	Any one of the 10 traffic paths (bridge mode), both RX IF, and TX data
Switching conditions	Switch to Redundant Modem following a unit fault,
	TX traffic alarm or RX traffic alarm
IF Switching	CRS-300 without CRS-280 IF Switch; IF ON / OFF control through the Switch controller. CRS-300 with CRS-280; all modem outputs on all the time.
Switching time	7 seconds max (Delay interval set to minimum (2 sec.))

Characteristic	Requirement
Modem Interface	- 25-pin D subminiature type male connector carrying all EIA-422, 232, LVDS data, alarm and remote control signals. - 15-pin D subminiature type male connector carrying all G.703 data, (balanced or unbalanced).
User Data Interfaces (Listed by TMI type)	• CRS-320 – EIA-422, 232, LVDS Interface (1) 25-pin 'D' type female connector EIA-422/530 DCE, V.35, Sync EIA-232, LVDS • CRS-330 - G.703 Balanced/Unbalanced Interface (1) 15-pin 'D' type female connector G.703 balanced, (DDI, DDO, IDI, IDO) (4) BNC type female connectors G.703 unbalanced, (DDI, DDO, IDI, IDO) • CRS-340 - EIA-422, 232, LVDS, G.703 Mixed Interface (1) 25-pin 'D' type female connector EIA-422/530 DCE, V.35, Sync EIA-232, LVDS (1) 15-pin 'D' type female connector G.703 balanced, (DDI, DDO, IDI, IDO) (2) BNC type female connectors G.703 unbalanced, (DDI, IDO) • CRS-370 – HSSI Interface (1) SCSI-2 type female connector HSSI (Interface types may be mixed in a redundancy group)
Front Panel	Vacuum fluorescent display, 2 lines, 24 characters, tactile keypad
	LED system status display showing, for all modems:
	Unit fault RX traffic alarm
	TX traffic alarm on-line/off-line status
	Bridge status
Audible Alarm	Can be programmed to activate following various changes of state
Common Faults	Dry relay contacts
Power Supply	Two independent inputs:
	100 to 250 volts AC, Auto-sensing
	Fused IEC connectors, 25 Watts maximum
Dimensions and weight	4U chassis - 10.8 in. deep (27.5 cm), 18.5 lbs. (8.4 kg.)
Compatible modems	CDM-600

Characteristic	Requirement
EMC and Safety Standards:	EN 55022 CLASS B (Emissions) EN 50082-1 (Immunity)
	EN 60950 (Safety) FCC Part 15 Class B
Environmental	Operating temperature range 0° to 40°C (32° to 104°F)

Table 1-2. CRS-280 Specifications

Characteristic	Requirement
Tx/Rx Operating Frequency	50 to 180 MHz
Return Loss	18 dB return loss into 75 Ω (50 Ω optional)
Tx to Tx Channel Isolation	> 50 dB
Rx to Rx Channel Isolation	> 50 dB
Tx to Rx Channel Isolation	> 60 dB
Number of Uplinks	1 to 10 Traffic Modems
Transmit IF Loss	< 1.5 dB over operating frequency
Receive IF Loss	< 5 dB over operating frequency
Tx / Rx Connectors	BNC female
Number of Downlinks	1 to 10 traffic units
Powering of IF Switch	From the CRS-300 chassis for 70 / 140 MHz

Table 1-3. CRS-350 Specifications

Characteristic	Requirement
Connector Types	25-pin 'D' type male connector ESC, overhead signals 15-pin 'D' type female connector IDR Alarms 9-pin 'D' type female connector Audio
Power	From CRS-300
Dimensions and Weight	3U chassis 4.0 in. deep (27.5 cm) 5 lbs. (2.2 kg.)
Environmental	Operating temperature range 0° to 40° C (32 to 104° F)

1.3.1 DIMENSIONAL ENVELOPE

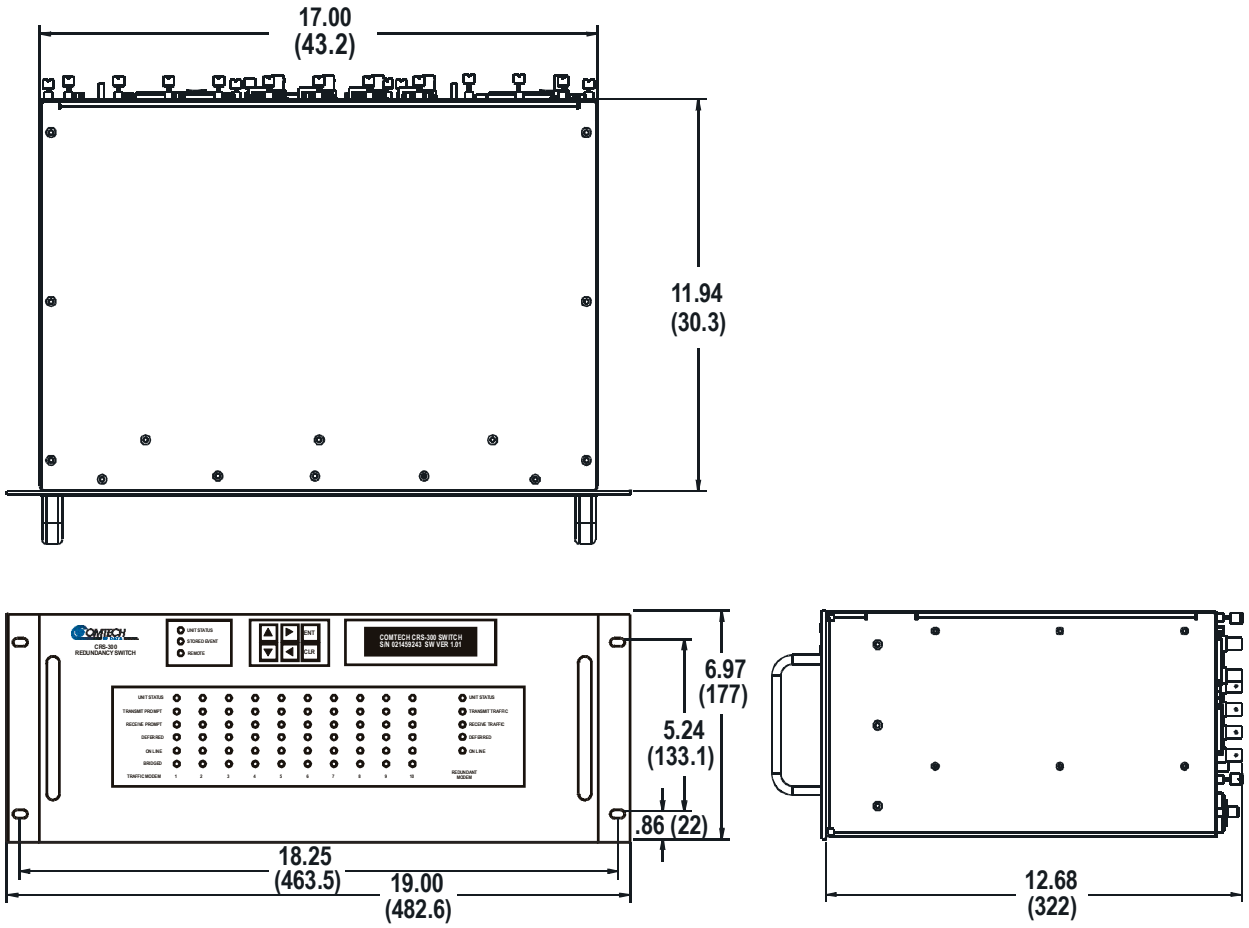


Figure 1-15. CRS-300 Dimensional Envelope

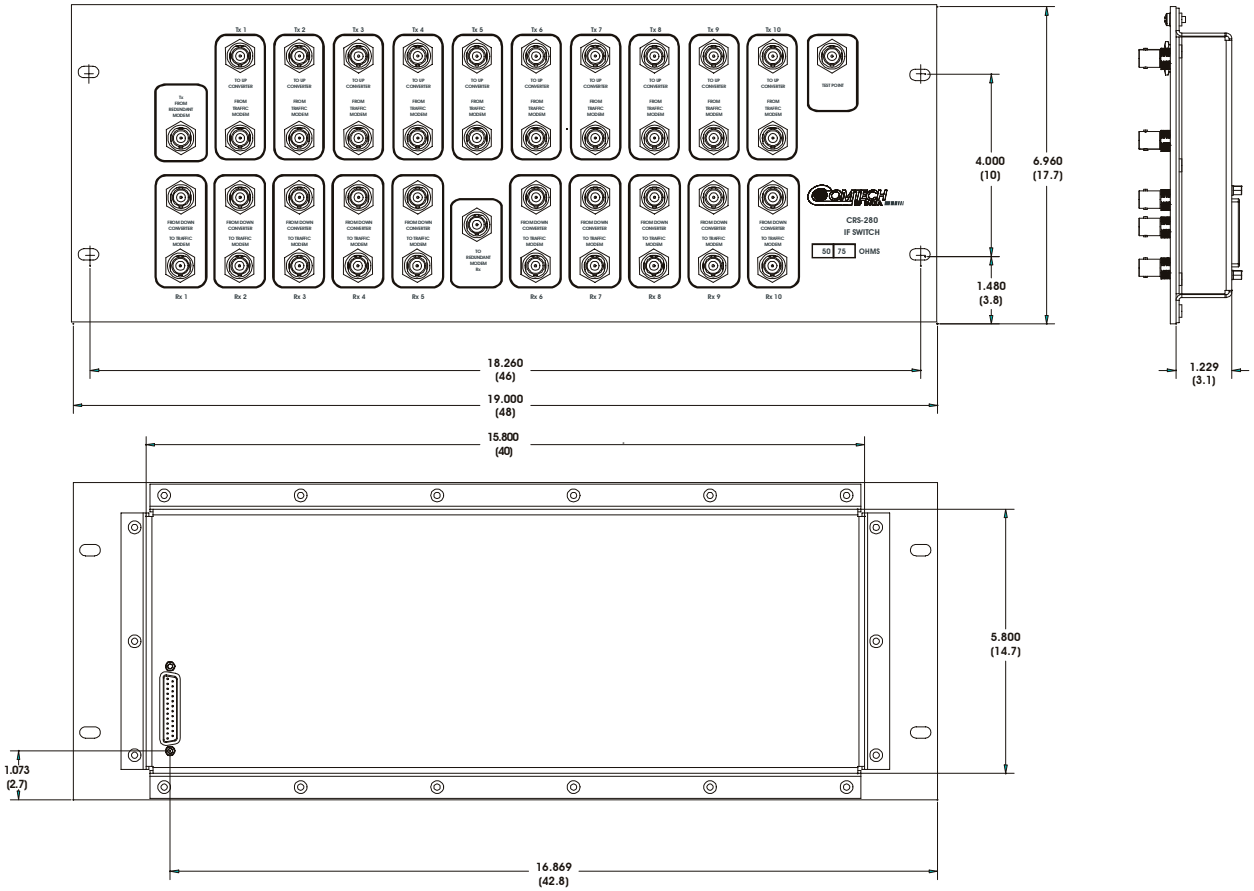


Figure 1-16. CRS-280 Dimensional Envelope

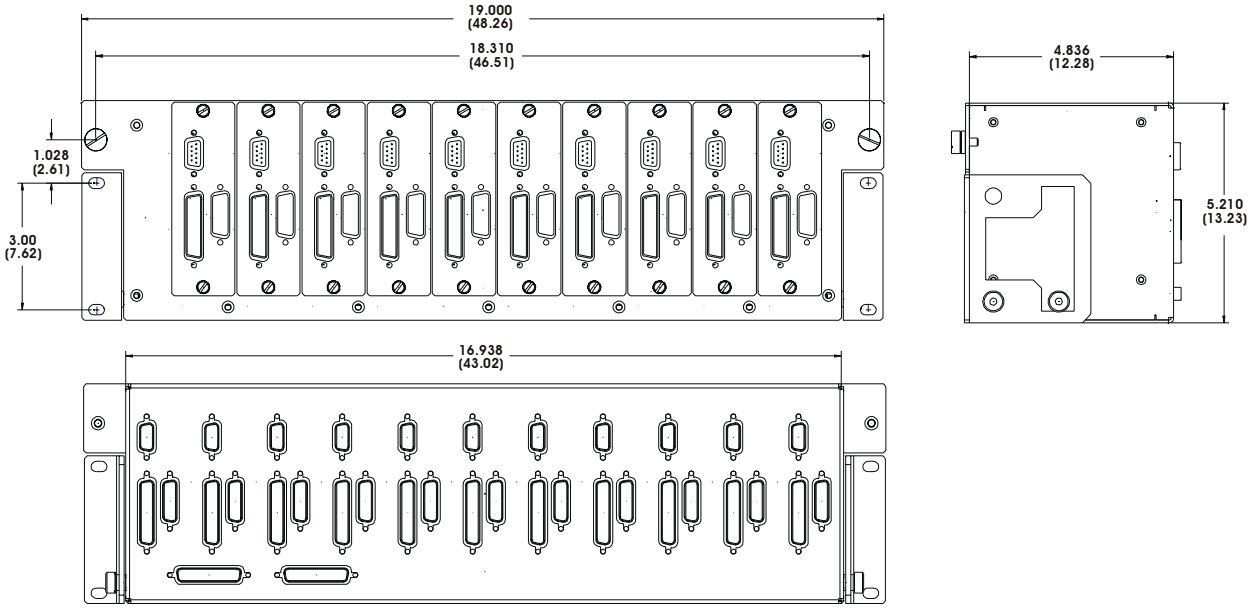


Figure 1-17. CRS-350 Dimensional Envelope

NOTES:

Chapter 2. Installation and Initial Setup

2.1 Unpacking and Inspection

1. Inspect shipping containers for damage.

   If shipping containers are damaged, keep them until the contents of the shipment have been carefully inspected and checked for normal operation.
2. Remove the packing list from the outside of the shipping carton.
3. Open the carton and remove the contents.
4. Check the contents against the packing list to verify completeness of the shipment.
5. If damage is evident, contact the carrier and Comtech EF Data immediately and submit a damage report.
6. If the unit needs to be returned to Comtech EF Data, use the original shipping container.

Note: Be sure to keep all shipping materials for the carrier's inspection.

2.2 System Requirements

For the CRS-300 to operate correctly, all Traffic Modems and the Redundant Modem must be of the same model. Permitted modem models are:

CDM-600 - Firmware Version 1.1.5 or later
CDM-600L – Firmware Version 1.1.1 or later
CDM-570 - Firmware version 1.4.1 or later
CDM-570L – Firmware Version 1.3.1 or later

If the modems do not meet this requirement, proceed as follows:
Go to: www.comtechefdata.com
Click on: downloads/flash upgrades/flash firmware data files/appropriate modem

Note: The Switch communicates with the attached modems via the 25-pin cable that provides the EIA-232 communication path. Each modem must be configured for communication: EIA-232, 9600 baud, 8-N-1, address 0 (default).

2.3 INSTALLATION

2.3.1 PROVIDE AIRFLOW

Typically, the CRS-300 is mounted in a rack along with all the Modems with which it is to operate, so it is important to ensure that there is adequate clearance for ventilation. Since the Switch itself is relatively passive, no additional clearance is needed between it and the nearest Modem.

In rack, systems where there is high heat dissipation, provide forced-air cooling by installing top- or bottom-mounted fans or blowers.

DO NOT ALLOW THE INTERNAL RACK TEMPERATURE TO EXCEED 50° C (122 ° F).

2.3.2 RACK MOUNTING INSTRUCTIONS

Mount the Switch using front panel screws only. Do not install rack slides to the side of the CRS-300 chassis. Contact the factory if there are questions about rack supports.

Typically, the CRS-300 is mounted in a rack along with all the Modems with which it is to operate, so it is important to ensure that there is adequate clearance for ventilation. Since the Switch itself is relatively passive, no additional clearance is needed between it and the nearest Modem.

In rack, systems where there is high heat dissipation, provide forced-air cooling by installing top or bottom-mounted fans or blowers.

2.3.3 INSTALLATION DETAILS

The CRS-300 is constructed as a 4U high rack-mounting chassis. Rack-handles at the front of the unit facilitate removal from and placement into a rack. Mount the Switch in the rack using the mounting holes on the front panel. Figure 2-1 is a side “cut-away” view of a typical rack configuration for modems combined with the CRS-300, CRS-280 and CRS-350.

The CRS-280 can be mounted on the back of the rack or on top.

The CRS-350 is intended to mount to the back of the rack. The mounting hardware allows the user to hinge the unit down to access the data cables in the rear of the unit to connect the cables to the modems.

Mount all modems in the rack.

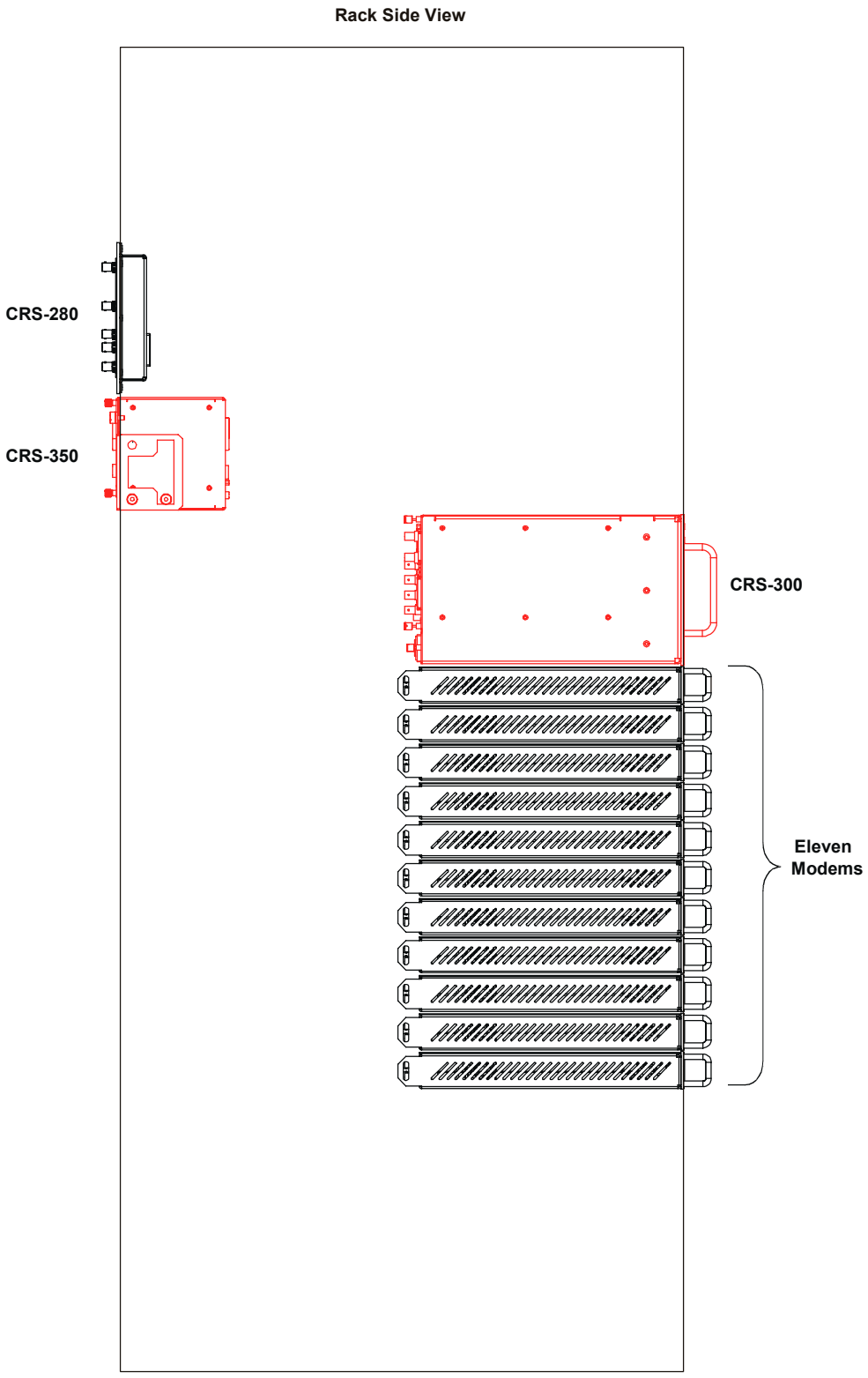


Figure 2-1. Typical Rack Mounting Configuration

2.4 CONNECTING THE CABLES

Once the Switch and all the modems have been mounted, the user must properly attach all required cabling and configure the system for correct operation. What follows is a step-by-step description of this process. Please leave the Switch and all modems powered off until all connections are ready.

2.4.1 PHYSICAL CABLE REQUIREMENTS

The 25- and 15-pin (for G.703) cables required between each modem and its plug-in card (TMI or RMI) should be of shielded, twisted-pair construction with the grounded shield bonded to the back shell. All pins should be wired to the same pin number at either connector (pin-to-pin), with a male connector at one end and female at the other (see CRS-300 Connector Pin-outs, section 2.8). The modem accepts the male end of the cable while the TMI or RMI accepts the female end into the port labeled "To Traffic Modem" or "To Redundant Modem". Depending upon the location of each modem in the rack, a length of from 2 to 5 feet is desirable. Appropriate data cables are available from Comtech EF Data, consult the factory for ordering information.

ALWAYS KEEP THE 25-PIN CABLE ATTACHED TO AN OPERATING SWITCH WHILE POWER IS SUPPLIED TO THE MODEM.

If a modem is to be added to an *operating* 1:N system, first attach these cables, and then apply power. If a modem is to be removed, first de-activate the modem from the Switch configuration (via menu: CONFIG, ACTIVE, down arrow for the appropriate TMI/modem position), then turn off modem power, and remove its 25-pin cable. This allows the Switch to always have control of a modem's Tx carrier, and prevent contention in the system.

The 25-pin cable provides the EIA-232 communication path between the Switch and the modems. Each modem must be configured for communication: EIA-232, 9600 baud, 8-N-1.

2.4.2 MODEM DATA CABLES

Connect all 25-pin and the 15-pin cables between the modems and their appropriate TMI or RMI cards. It is important that all modems have the same software revision and installed options so that the Redundant Modem can properly mimic all Traffic Modems. If there are unused positions on the Switch, ensure these are de-activated in the "CONFIG, ACTIVE" menu. Table 2-1 provides added clarity on where cable ends are connected.

Table 2-1. CRS-300 to Modem Data Connections

Module	CRS-300 I/O	Connection to modem
CRS-310 RMI	P1 P2 J2 J3 J1	**Data Interface (**P3B) **Balanced G.703 (**P7) n/a n/a n/a
CRS-320 TMI	P1 J1	**Data Interface (**P3B) User Data
CRS-330 TMI	P1 P2 J1-6	**Data Interface (**P3B) **Balanced G.703 (**P7) User Data
CRS-340 TMI	P1 P2 J1-4	**Data Interface (**P3B) **Balanced G.703 (**P7) User Data
CRS-370 TMI	P1 J1	**Data Interface (**P3B) User Data

Figure 2-2 shows typical cable connection between the switch and the modems (Traffic Modem #1, #3, #5, #7 and Redundant Modem only shown).

FOR G.703. ALWAYS USE THE 15-PIN CONNECTION BETWEEN THE MODEM AND THE SWITCH, FOR BALANCED OR UNBALANCED DATA.

ENSURE THAT ALL POWER TO THE EQUIPMENT IS OFF.

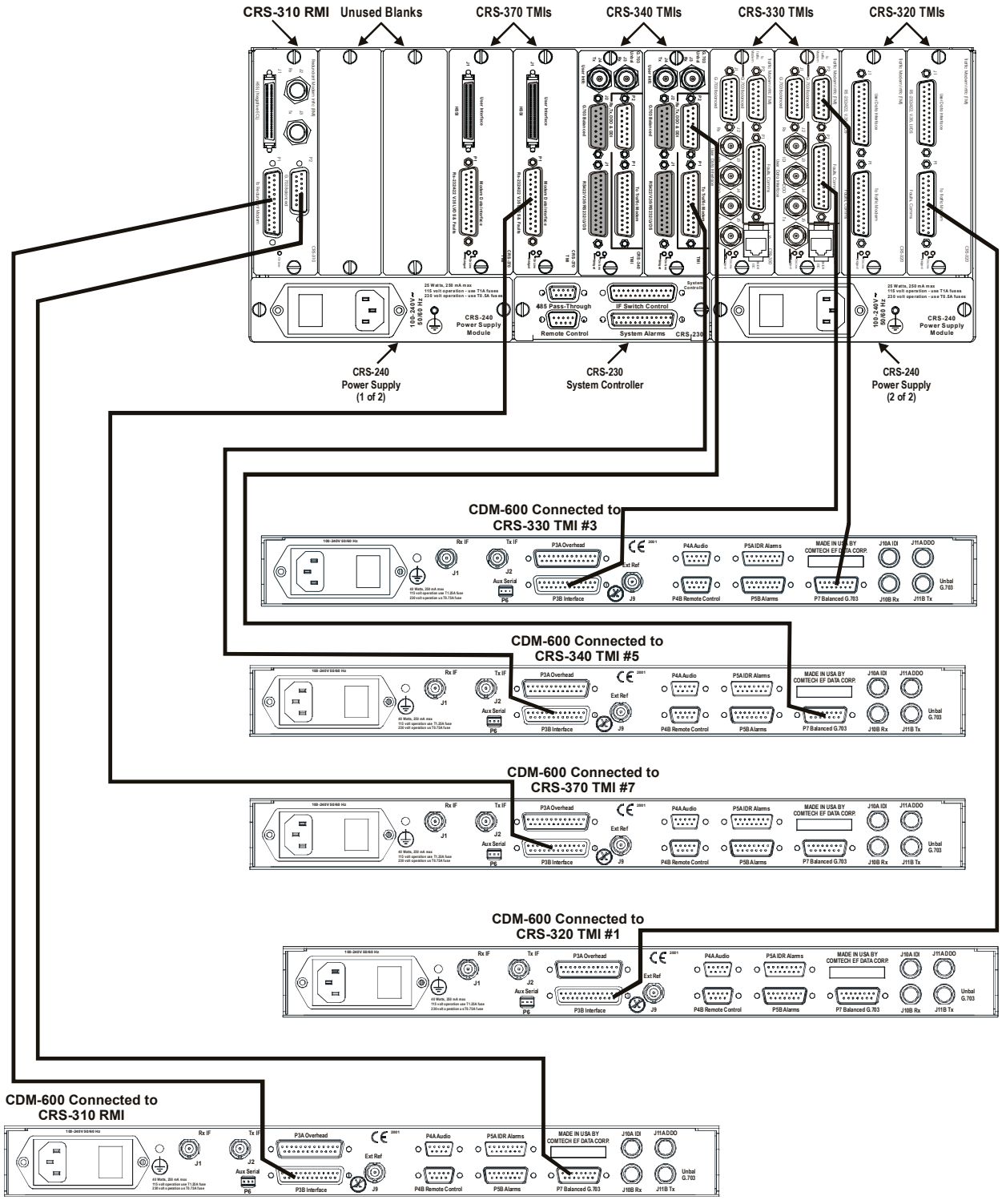


Figure 2-2. Cabling example for CRS-300 to CDM-600 Modems (Connections shown for RMI & TMIs 1, 3, 5, and 7 only)

2.4.3 EXTERNAL DATA CONNECTION

When each cable is connected between the modem and its plug-in card, the user's terrestrial data connection to the external router, multiplexing equipment or test data generator should be made to any of the connectors on the TMI labeled "User Data Interface". These replace the direct connection to the Traffic Modem's "Data Interface" port.

If the data type is G.703 and the CRS-330 or CRS-340 TMI is being used, the user can connect to either the female DB-15 or the BNC connectors on the TMI, (for balanced or unbalanced data), just as he would as if he was connecting directly to the modem.

Ensure that the correct G.703 balanced or unbalanced selection is made on the modem.

Note: The RMI does not have this connector, as the Redundant Modem's function is to replace a faulted Traffic Modem. Even with the Switch turned off, this should complete the terrestrial data paths between each Traffic Modem and its external equipment so that the modems may now be switched on.

2.4.4 CONTROL CABLE FOR OPTIONAL CRS-280 AND CRS-350

If the user's redundancy system requires the Comtech CRS-280 IF Switch and/or CRS ESC Switch, a control cable will need to be connected between them. Figure 2-3 shows the connection if the system requires only the CRS-280.

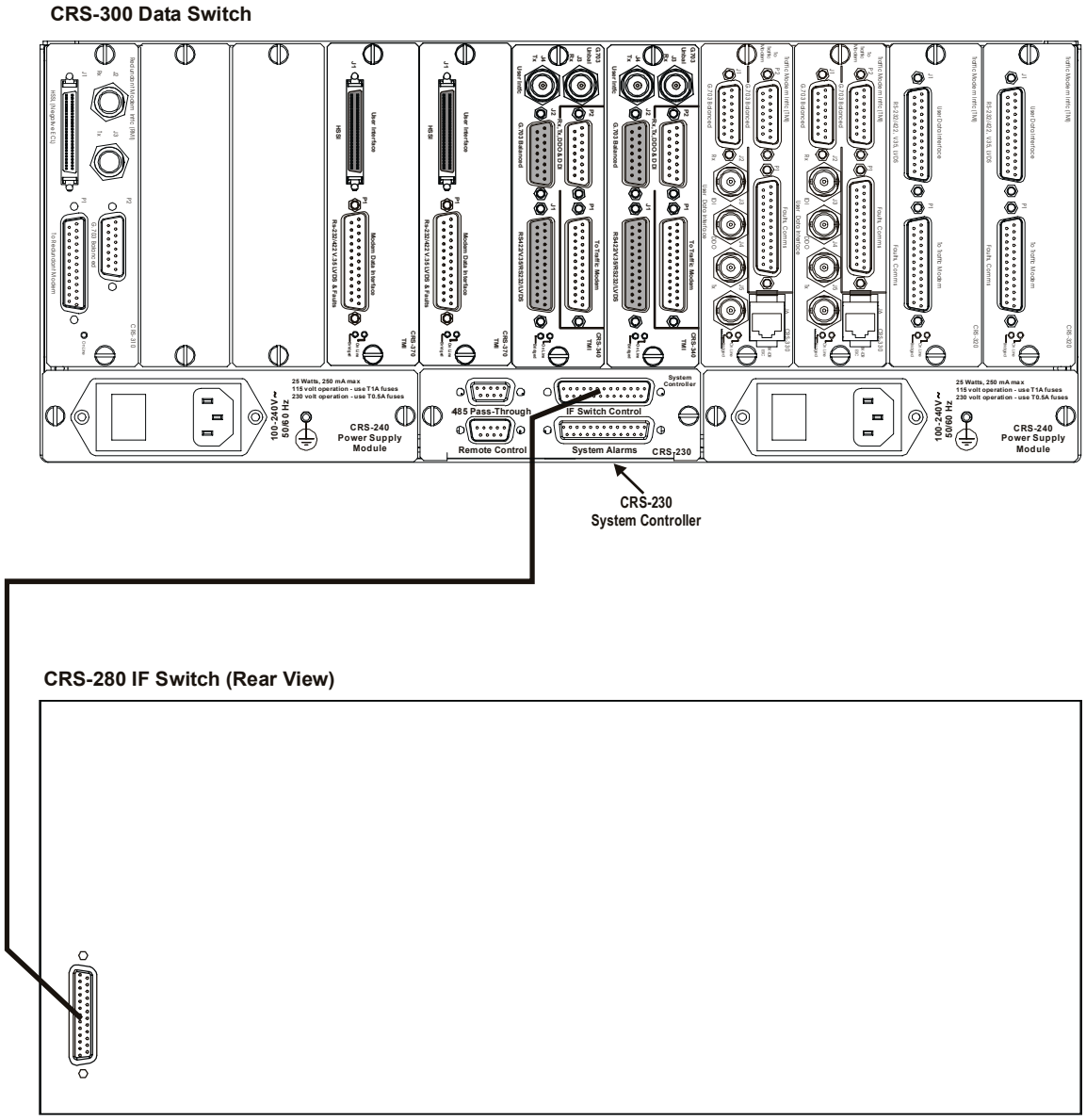


Figure 2-3. Control Cable Connection for CRS-280

Figure 2-4 shows the connection if the system requires both the CRS-280 and the CRS-350.

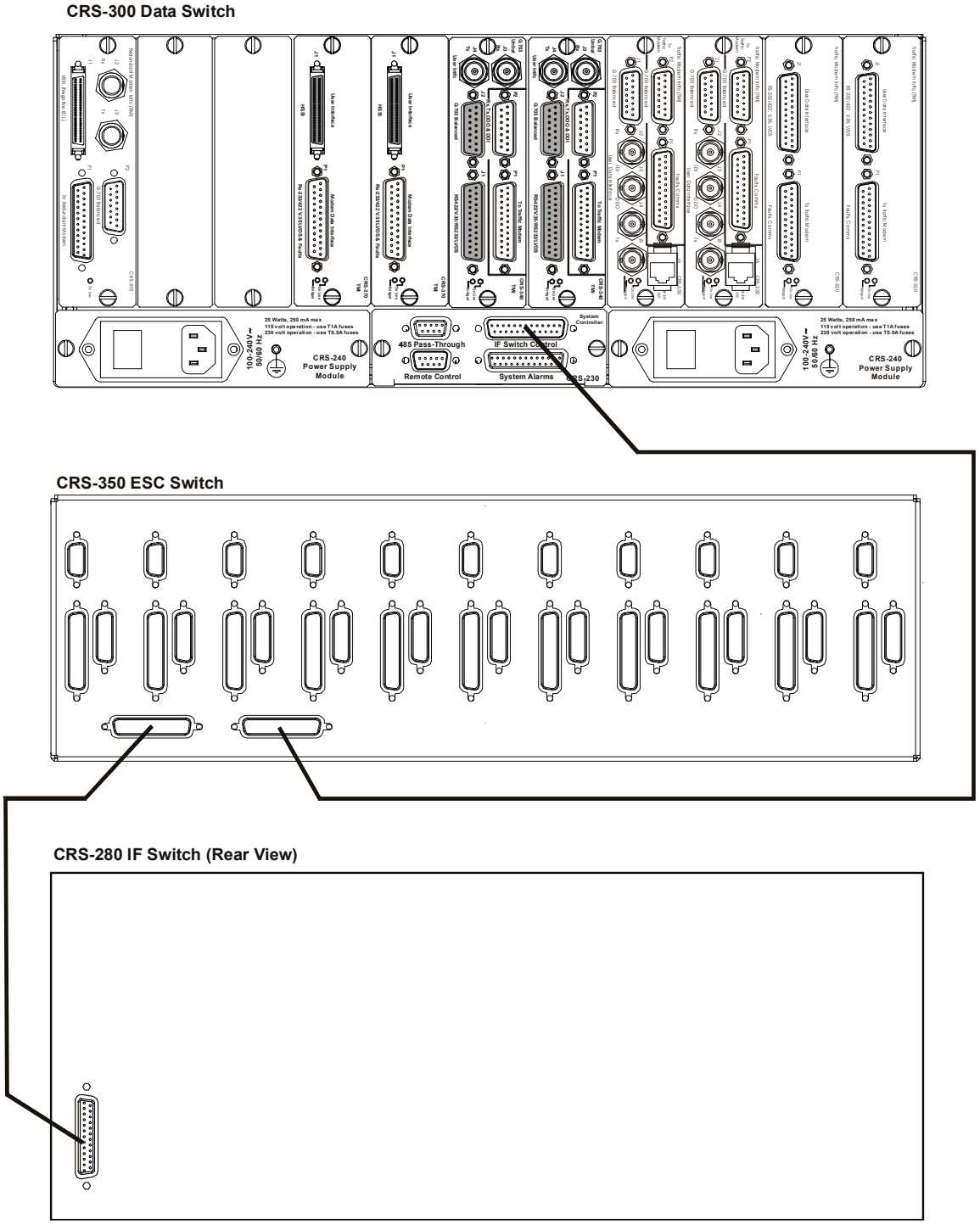


Figure 2-4. Control Cable Connection for CRS-350 and CRS-280

2.4.5 CRS-350 TO MODEM CABLES

Connect the cables from the modems to the back panel of the CRS-350 ESC Switch as shown in Figure 2-5.

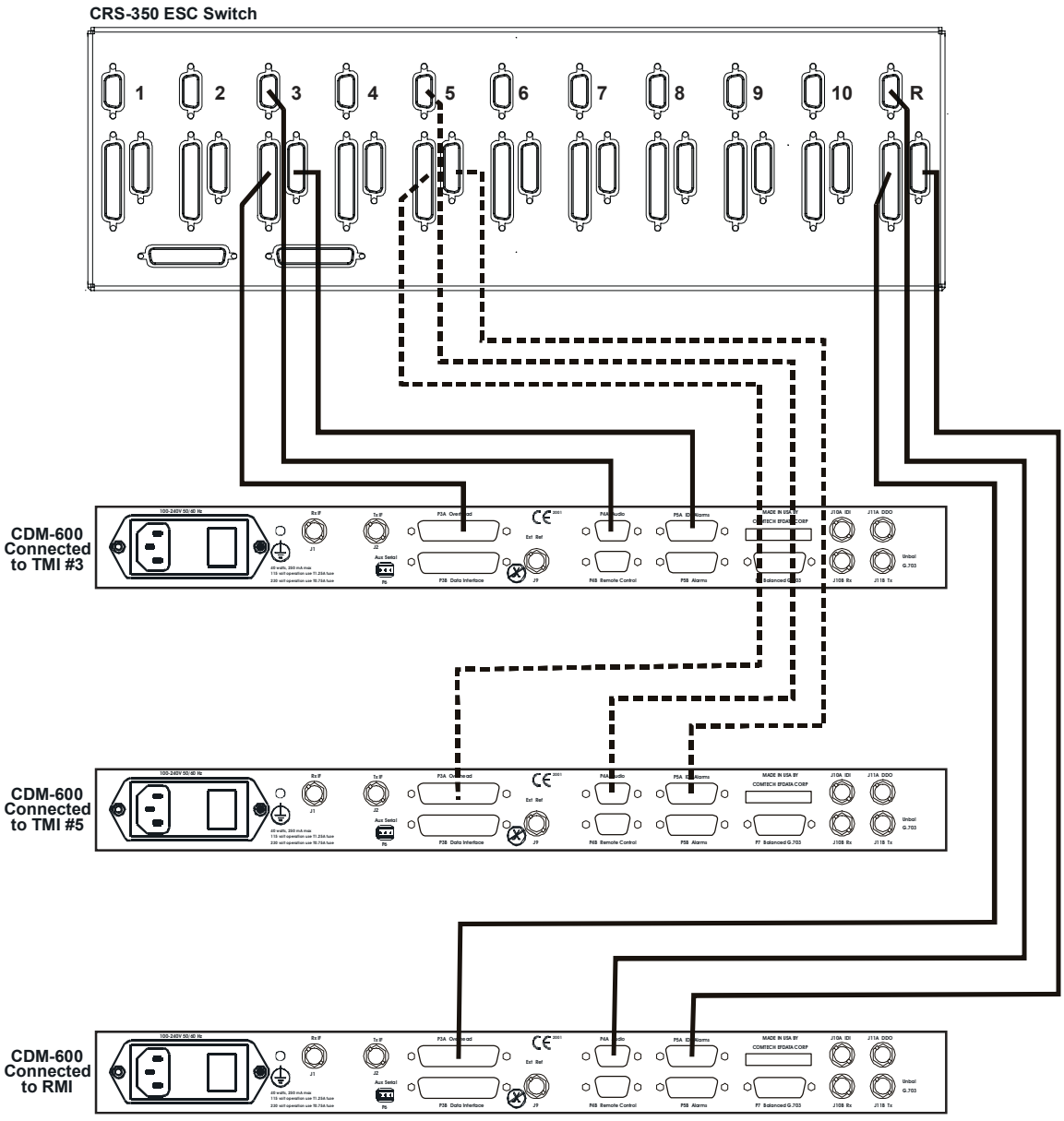


Figure 2-5. Cabling example for CRS-350 ESC to CDM-600 Modems (Connections Shown for RMI and TMIs 3 & 5 Only)

2.4.6 CRS-350 EXTERNAL USER INTERFACE

When each cable is connected between the modem and the CRS-350, the user's IDR, Audio and Overhead connection to the users equipment should be made to the correct corresponding plug-in card on the front of the CRS-350. This replaces the direct connection to the Traffic Modem's "IDR", "Audio", and "Overhead" ports.

2.5 APPLYING POWER TO THE SWITCH

Note: Each CRS-300 is shipped with two power supplies, and it is recommended that both be used for maximum reliability.

Complete the cabling as indicated in the previous section.

Apply power to the modems. Configure the modems for remote communications: EIA-232, 9600 baud, 8-N-1. The IF ports may be left unconnected.

Attach power cord to both of the switch power supplies. Apply power to the CRS-300 (2 switches). The auto-sensing AC power supplies do not require any adjustments. The Switch should show a green Unit Status. If the status LED is red, go to MONITOR, SW-ALARM to view the faults. If the Redundant Modem is not correctly attached and configured (comms: EIA-232, 9600 baud, 8-N-1), the LED will be red.

The IEC line input connector for each Power Supply Module contains the ON/OFF switch for that module. It is also fitted with two fuses, one each for line and neutral connections (or L1, L2, where appropriate). These are contained within the body of the connector, behind a small plastic flap.

- For 115/230 volt AC operation, use T1A fuses, (slow-blow) 20 mm fuses.

FOR CONTINUED OPERATOR SAFETY, ALWAYS REPLACE THE FUSES WITH THE CORRECT TYPE AND RATING.

2.5.1 SINGLE POWER SUPPLY OPERATION (TEST)

If only one power supply module is used, mask the fault for the unused power supply as follows:

1. Go to the CONFIG, OPTIONS, MASKS, and SW-ALARMS menu.
2. Select to mask the unused power supply.

The Switch is now ready for the next procedure, configuring the Switch.

2.6 CONFIGURING THE SWITCH

The unit was shipped with the following default configuration:

- No units (modems) are active.
- The Switch was set to Manual operating mode. (This Manual setting causes the Stored Event LED to blink.)

Use the front panel keypad and display to configure the Switch as described in the following paragraphs.

2.6.1 ACTIVATE THE DESIRED TRAFFIC MODEMS

Ensure that the Redundant Modem installation is complete and that it is operating correctly prior to activating any Traffic Modems.

An active Traffic Modem is going to be polled regularly by the Switch.

a. Configure each Modem for correct communications via the modem front panel: CONFIGURATION, REMOTE,

b. Select REMOTE, EIA-232, 9600 baud, 8-N-1.

c. Press the CLEAR key to exit the lower menus. (If the unit is a Traffic Modem, it may then be configured to LOCAL mode.).

It is possible to operate the Switch without all 10 TMI slots filled. A TMI may only be made 'active' if it is present.

1 Go to the CONFIG, ACTIVE menu.

2 Activate all desired Traffic Modems, using the up arrows.

After ENTER is pressed, the Switch Status LED will turn red, until the Switch has polled each of the activated Modems, and correctly programmed the bridged Modem configuration into the Redundant Modem. Once the programming is completed successfully, the red LED will turn green.

Note: The Redundant Modem takes several seconds to configure. If the LED remains red, check the communication status using the menus: MONITOR: COMM-STATE or MONITOR: SW-ALARMS to investigate the problem.

2.6.2 VERIFY REMOTE COMMUNICATIONS TO EACH ACTIVE MODEM

The LEDs are arranged in columns corresponding to each modem, and should accurately reflect the status of each.

1. Verify that the Status LED for each modem shows a green light, indicating no faults. (The 3 alarm LEDs will reflect the LEDs on the front panel of each modem.)
2. Verify that the Online LED is lit for all connected TMIs with the modems attached.
3. Verify that the Online LED is not lit for the Redundant Modem (for systems not using the CRS-280 IF Switch).
4. Verify that the Bridge LED is lit for only one Traffic Modem.

Notes:
1. For modems - Use the INFO and MONITOR menus to view the status of the modems, in addition to viewing the LEDs.
2. For Switch - Use MONITOR: COMM-STATE to verify the modems that are responding via remote control.

The Switch is now ready for the next procedure, configuring the IF Carriers.

2.7 CONFIGURING THE IF CARRIERS

Configure the IF carriers for all the Modems. There are two configuration methods; single transponder and multiple transponders.

a. For a single transponder, all the Modems are connected to the same up/down converter.

b. For multiple transponders, the Modems may be grouped and connected in various combinations to multiple up/down converters. The CRS-280 IF Switch is required for multiple transponder operation.

Proceed with the transponder configuration method applicable to your system.

2.7.1 CONFIGURING AND CABLING FOR A SINGLE TRANSPONDER

2.7.1.1 TRANSMIT SIDE

1. Configure each Modem's transmit settings to the proper data rate, IF frequency and output power level.
2. Combine the carriers (with user-supplied BNC cables) into a single power combiner.
3. Feed the output of the combiner to the up converter.

Ensure that the impedance for the Modems' cables and combiner are the same to prevent problems resulting from a mismatch.

2.7.1.2 RECEIVE SIDE

1. Attach the output of the down converter (with user-supplied BNC cables) to a single splitter.
2. Feed the output of the splitter into the Receive IF ports of the Modems.

When a Traffic Modem is taken offline, its Transmit IF is shut down automatically by the Switch and is replaced by the Redundant Modem IF.

2.7.2 CONFIGURING AND CABLING FOR MULTIPLE TRANSPONDERS USING THE CRS-280 IF SWITCH

The CRS-280 provides complete isolation of the IF signals. The Redundant Modem IF signals are routed to the Traffic Modem IF path when the RMI is online. Once connected, the CRS-300 automatically senses the presence of the CRS-280. The CRS-300, upon switching, leaves the offline modem with its RF on, and the CRS-280 Switch relays isolate any undesired signals.

1. Refer to Figure 2-6 and Table 2-2 below for a complete listing of the CRS-280 IF connections.
2. Connect the Tx and Rx IF of each Modem to the CRS-280 with the correct IF cables.

The same IF connections are used between the CRS-280 and all modems as shown in Table 2-2.

Table 2-2. CRS-280 IF Switch Connections

From CRS-280	To Other	To Modem
Tx BU	-	Tx IF, Ch Bu
Tx1	-	Tx IF, Ch1
Tx2	-	Tx IF, Ch2
Tx3	-	Tx IF, Ch3
Tx4	-	Tx IF, Ch4
Tx5	-	Tx IF, Ch5
Tx6	-	Tx IF, Ch6
Tx7	-	Tx IF, Ch7
Tx8	-	Tx IF, Ch8
Tx9	-	Tx IF, Ch9
Tx10	-	Tx IF, Ch10
Switch Control	CRS-230 IF Switch Control	-

From CRS-280	To Modem
Rx1	Rx IF, Ch1
Rx2	Rx IF, Ch2
Rx3	Rx IF, Ch3
Rx4	Rx IF, Ch4
Rx5	Rx IF, Ch5
Rx Bu	Rx IF, Ch Bu
Rx6	Rx IF, Ch6
Rx7	Rx IF, Ch7
Rx8	Rx IF, Ch8
Rx9	Rx IF, Ch9
Rx10	Rx IF, Ch10
-	-

Once the applicable transponder configuration and cabling has been completed, the Switch is ready for the next procedure, Configuring Automatic Operation Mode.

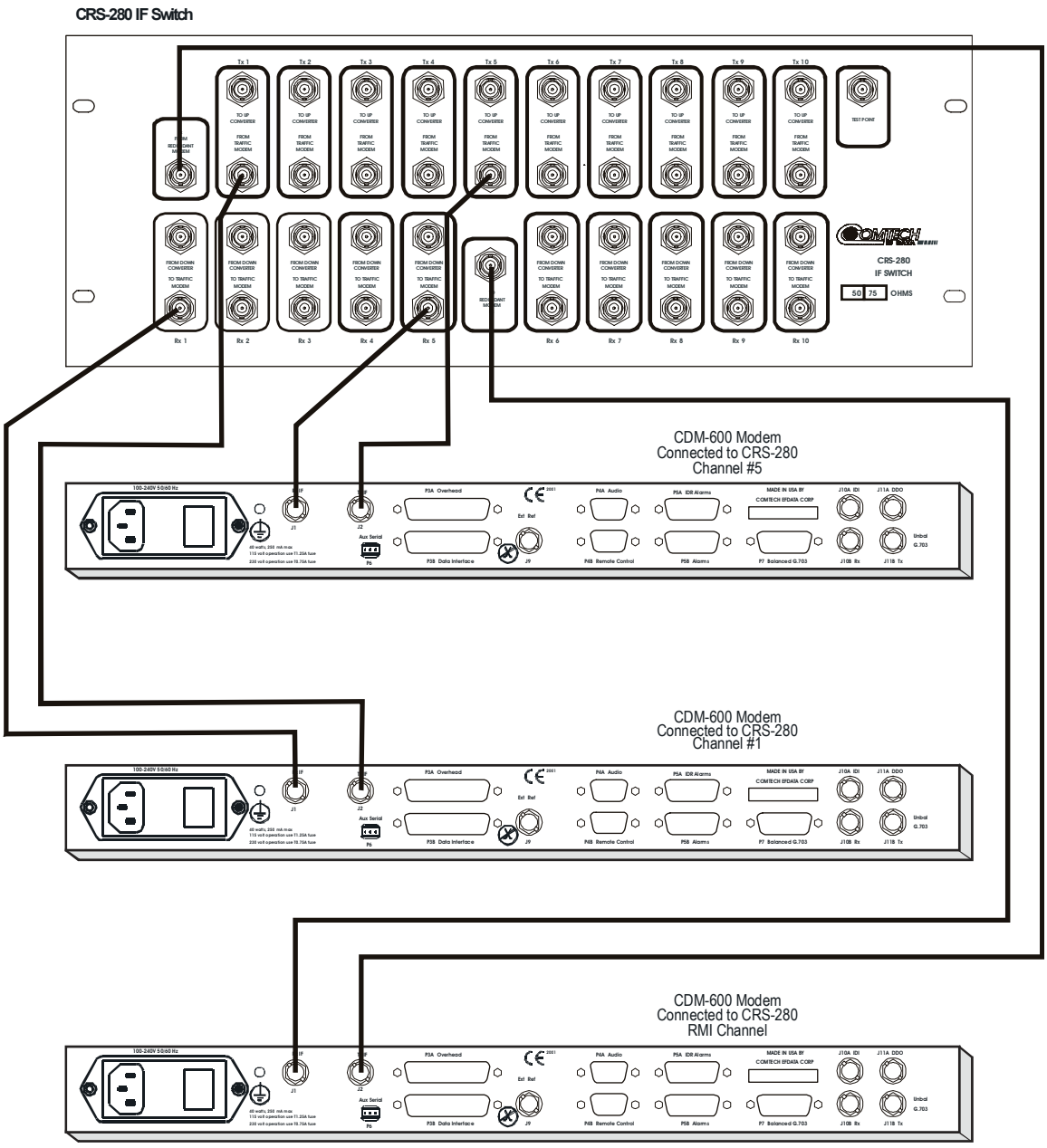


Figure 2-6. Cabling example CRS-280 to CDM-600 Modems (RMI and Channels #1 & 5 Only Shown)

2.7.3 MANUAL MODE OPERATION

After the IF cabling is finished, the system should be completely operational; however, it is still operating in Manual mode. While in the Manual mode, the user can manually select which Traffic Modem will be bridged or backed-up.

While in Manual mode, the Switch does not *automatically* react to any Traffic Modem failures it detects. Comtech EF Data recommends that an unattended system be configured to operate in Auto mode.

2.7.4 AUTOMATIC MODE OPERATION

When Auto mode is enabled, the first active Modem that fails is first bridged by the Redundant Modem, and then backed up. To enable AUTO mode:

1. Go to the CONFIG, AUTO menu and turn on AUTO mode.
2. Verify that the Stored Event LED stops blinking.

Additional configuration settings are useful for fine-tuning the Switch's Auto mode. These settings, Backup Holdoff, Restore Holdoff, and Alarm Mask are described next.

2.7.5 BACKUP HOLDOFF OPERATION

When in Auto mode, additional delays may be introduced to the backup procedure by setting the number of seconds for a "backup holdoff". The default backup holdoff period is 10 seconds (a minimum of 2 seconds is allowed).

If a Traffic Modem fails, the Switch waits for the backup holdoff time to determine two things: 1) does the Traffic Modem remain faulted, and 2) is the Redundant Modem not exhibiting the same fault? If the answer is yes to both questions for the entire backup holdoff time, then the Switch first bridges the faulted modem with the Redundant Modem. If the fault is sustained, then the switchover to the Redundant Modem is completed and the traffic is carried by the Redundant Modem.

A Holdoff time prevents unwarranted backups due to an intermittent fault.

Note: There will be no switchover if the Redundant Modem is faulted. Ensure that the Holdoff times are long enough (default 10 seconds) for the Redundant Modem to be configured and to lock onto the signal.

2.7.5.1 SET THE BACKUP HOLDOFF PERIOD

1. Go to the CONFIG, OPTIONS, HOLDOFFS menu.
2. Change the BACKUP HOLDOFF to any number in the range of 2 to 99 seconds.

2.7.6 RESTORE HOLDOFF OPERATION

The "Restore Holdoff" setting, which is also programmable from 2 to 99 seconds, determines the Switch's ability to automatically put a backed up Traffic Modem online again if its fault goes away. Normally, a failed Modem that was taken offline will remain offline indefinitely. If the fault goes away, traffic will be returned to the unit (in Auto mode) only if another Traffic Modem then fails. If the fault on the originally failed Modem has been clear for the full programmed Restore Holdoff time, the Switch places that Modem back online, and bridges the newly faulted Modem. If the new fault is sustained, the Redundant Modem can then be used to backup the newly faulted Modem.

The Switch deals with Traffic Modem failures on a "first come, first serve" basis. If the user sets the Switch to bridge the highest priority circuit, switching time will be minimized in the event of a failure. If two faults occur simultaneously, and are both sustained for the holdoff time, the lower number circuit will be backed up.

2.7.6.1 SET THE RESTORE HOLDOFF PERIOD

1. Go to the CONFIG, OPTIONS, HOLDOFFS menu.
2. Change the RESTORE HOLDOFF to any number in the range of 2 to 99 seconds.

2.7.7 ALARM MASKING

Another way to adjust the Switch's reaction in Auto mode is to mask Modem faults. The user may disable modem Rx, Tx or both fault types so that the Switch does not react to them. This masking prevents the Switch from taking automatic action and prevents the logging of the faults in the stored events list.

Note: These masks are global to all the Modems attached to the Switch.

2.7.7.1 SET THE ALARM MASKS

1. Go to CONFIG, OPTIONS, MASKS, and MODEM-ALARMS.
2. Set the mask parameters as desired.

Note: Read the manual for the modem being used. Details of the Modem operation are not covered in the CRS-300 manual.

Once the Switch has been installed and setup has been completed, regular operation may begin. Please refer to Chapter 3, Front Panel Operation, for more information.

2.8 CRS-300 CONNECTOR PIN-OUTS

2.8.1 CRS-230 CONTROLLER CONNECTORS

2.8.1.1 SYSTEM ALARMS CONNECTOR - 25 PIN 'D' TYPE FEMALE

Table 2-3. System Alarms Connector

Pin	Description
1	Backup Traffic Modem Common
2	Backup Traffic Modem #9 – Normally Open
3	Backup Traffic Modem #7 – Normally Open
4	Backup Traffic Modem #5 – Normally Open
5	Backup Traffic Modem #3 – Normally Open
6	Backup Traffic Modem #1 – Normally Open
7	Ground
8	Form-C Fault Relay Common
9	Switch Unit Fault – Normally Closed
10	Modem Summary Unit Fault – Normally Closed
11	Modem Summary Tx Traffic Fault – Normally Closed
12	Modem Summary Rx Traffic Fault – Normally Closed
14	Backup Traffic Modem #10 – Normally Open
15	Backup Traffic Modem #8 – Normally Open
16	Backup Traffic Modem #6 – Normally Open
17	Backup Traffic Modem #4 – Normally Open
18	Backup Traffic Modem #2 – Normally Open
20	Audio Indicator (Gnd = Audio on Float = Audio off)
21	Switch Unit Fault – Normally Open
22	Modem Summary Unit Fault – Normally Open
23	Modem Summary Tx Traffic Fault – Normally Open
24	Modem Summary Rx Traffic Fault – Normally Open
25,13,19	No Connection

Note: Normally Open refers to the NON-FAIL state

2.8.1.2 IF SWITCH CONTROL CONNECTOR - 25 PIN 'D' TYPE MALE

The IF Switch Control connector should be cabled directly to the corresponding connector on the CRS-280 or CRS-350 Switch, if used. This supplies power to the CRS-280/350, along with the logic interface to drive the currently selected Traffic Modem, and to decide whether the system is in bridged or back-up mode. The CRS-280/350 must perform the same bridging and backing up functions of the Tx and Rx IF signals to match what the CRS-300 does to the terrestrial data signals. Table 2-4 provides the pinout information.

Table 2-4. IF Switch Control Connector, 25-Pin D Type Male

Pin #	Condition
16	Enable
5	Clock
17	Serial Data
4	Modem_Backup
8	N/A
3	Rev_Bit0, (for PCA hardware revision control)
18	Rev_Bit1
6	Rev_Bit2
19	Rev_Bit3
7	Product_ID_Bit0, (for IF Switch identification)
20	Product_ID_Bit1
21	IF Switch Present
10, 22	+5V input
12, 24	+12V input
11, 13	Ground
1, 2, 9, 14, 15	No Connection

2.8.1.3 REMOTE CONTROL CONNECTOR- 9 PIN 'D' TYPE MALE

The Remote Control connector provides access to the remote control ports of the Switch, both EIA-232 and EIA-485. Table 2-5 provides the pinout information.

Table 2-5. Remote Control Connector, 9-Pin D Type Male

Pin #	Description	Direction
1	Ground	
2	EIA-232 Transmit Data	Out
3	EIA-232 Receive Data	In
4	Reserved - do not connect to this pin	
5	Ground	
6	EIA-485 Receive Data B *	In
7	EIA-485 Receive Data A *	In
8	EIA-485 Transmit Data B	Out
9	EIA-485 Transmit Data A	Out

* Use for 2-wire EIA-485 operation.

2.8.1.4 DATA CONNECTOR, (RS232/422/V.35/LVDS) – 25 PIN 'D' TYPE FEMALE

Table 2-6 is for the TMI User Data Interface connector (RS232/422/V.35/LVDS) P2 on CRS-320 and CRS-340.

Table 2-6. Data Connector

Pin	Generic Signal description	Direction	EIA-422/ EIA 530	V.35	EIA-232	Circuit No.
1	Shield	-	Shield	FG	AA	101
2	Transmit Data A	DTE to Modem	SD A	SD A	BA	103
3	Receive Data A	Modem to DTE	RD A	RD A	BB	104
7	Signal Ground	-	SG	SG	AB	102
8	Receiver Ready A	Modem to DTE	RR A	RLSD *	CF	109
9	Receive Clock B	Modem to DTE	RT B	SCR B	-	115
10	Receiver Ready B	Modem to DTE	RR	B	-	109
11	Transmit Clock B	DTE to Modem	TT B	SCTE B	-	113
12	Internal Transmit Clock B	Modem to DTE	ST B	SCT B	-	114
14	Transmit Data B	DTE to Modem	SD B	SD B	-	103
15	Internal Transmit Clock A	Modem to DTE	ST A	SCT A	DB	114
16	Receive Data B	Modem to DTE	RD B	RD B	-	104
17	Receive Clock A	Modem to DTE	RT A	SCR A	DD	115
23	External Carrier Off (EIA-232 ‘1' or TTL ‘low’)	DTE to Modem	-	-	-	-
24	Transmit Clock A	DTE to Modem	TT A	SCTE A	DA	113

Notes:
1. Receiver-Ready is an EIA-232-level control signal on a V.35 interface.
2. DO NOT connect signals to pins which are not shown - these pins are reserved for use by the redundancy system
3. 'B' signal lines are not used for EIA-232 applications
4. For X.21 operation, use the EIA-422 pins, but ignore Receive Clock if the Modem is DTE, and ignore Transmit clocks if the Modem is DCE.

2.8.1.5 DATA CONNECTOR, (G.703, BALANCED) – 15 PIN 'D' TYPE FEMALE

Table 2-7 is for the TMI User Data Interface connector (Balanced G.703) on the CRS-330 and CRS-340.

Table 2-7. Balanced G.703 Interface Connector Pin Assignments

Pin #	Signal Function	Name	Direction
1*	Tx, Drop Data Input (-)	DDI–	In
9*	Tx, Drop Data Input (+)	DDI+	In
2	Ground	GND	
10	Not Used		
3*	Rx, Insert Data Output (-)	IDO–	Out
11*	Rx, Insert Data Output (+)	IDO+	Out
4	Ground	GND	
12	Drop Data Output (-)	DDO–	Out
5	Drop Data Output (+)	DDO+	Out
13	Insert Data Input (-)	IDI–	In
6	Insert Data Input (+)	IDI+	In
14	Not Used		
7	Not Used		
15	External Carrier Off (EIA-232 ‘1’ or TTL ‘low’)	Tx_IF_Off	DTE to Modem
8	Not Used		

* Use for all non-Drop and Insert and T2/E2 balanced applications.

2.8.1.6 DATA CONNECTOR, (G.703, UNBALANCED) – BNC TYPE MALE

Table 2-8 is for the TMI User Data Interface BNC connectors (Unbalanced G.703) on the CRS-330 and CRS-340.

Table 2-8. Data Connector (G.703 Unbalanced)

BNC Connector	TMI CRS-330 Reference	TMI CRS-340 Reference	Description	Direction
Rx-IDO	J2	J3	Rx, G.703	Out
Tx-IDI	J5	J4	Tx, G.703	In
IDI	J3	—	Insert data input	In
DDO	J4	—	Drop data output	Out

2.8.1.7 DATA CONNECTOR, (HSSI) – 50 PIN 'D' TYPE FEMALE

Table 2-9 is for the TMI User Data Interface connector, (HSSI). This is a 50-pin SCSI-II female connector located on the CRS-370.

Table 2-9. HSSI Pinout (J1) 50-Pin Mini-D/SCSI-2 Female

HSSI/EIA-613 Interface Connector Pinout -- J1 To Modem				
Signal Function	**HSSI Signal**	**EIA-613 Circuit**	**Pin # (+, -)**	**Circuit Direction**
Signal Ground	SG	102	1, 26	
Receive Timing	RT	115	2, 27	from DCE
DCE Available	CA	107	3, 28	from DCE
Receive Data	RD	104	4, 29	from DCE
Loopback Circuit C	LC	undefined	5, 30	from DCE
Send Timing	ST	114	6, 31	from DCE
Signal Ground	SG	102	7, 32	
DTE Available	TA	108/2	8, 33	to DCE
Terminal Timing	TT	113	9, 34	to DCE
Loopback Circuit A	LA	143	10, 35	to DCE
Send Data	SD	103	11, 36	to DCE
Loopback Circuit B	LB	144	12, 37	to DCE
Signal Ground	SG	102	13, 38	
Reserved (to DCE)			14,15,17, 18, 39 - 43	not used
Tx_Carrier_Off_L[1, 3]	CO	undefined	16	from DTE

HSSI/EIA-613 Interface Connector Pinout -- J1 To Modem				
Signal Function	**HSSI Signal**	**EIA-613 Circuit**	**Pin # (+, -)**	**Circuit Direction**
Signal Ground	SG	102	19, 44	
Carrier Detect (lock) [1, 2]	CD	undefined	20	from DCE
Reserved (to DTE)		undefined	21-24 46-49	not used
Signal Ground	SG	102	25, 50	

Notes: 1 Noted signal function names are non-HSSI defined signals. On Cisco™ routers, there is no connection to those pins.

2 TTL - output.

3 TTL or RS232 (active low) input

2.8.1.8 8 kHz IDR Connector – RJ-45

The RJ-45 connector on the CRS-330 TMI is the user interface to the RS-422 clock and data for the 8 kHz IDR Engineering Service Channel.

Table 2-10. 8 kHz-IDR ESC Interface Connector Pin Assignments

Pin #	Signal Function	Name	Direction
1	Tx Data+	SD+	In
2	Tx Data-	SD-	In
3	Rx Data+	RD+	Out
4	Tx Clock+	ST+	Out
5	Tx Clock-	ST-	Out
6	Rx Data-	RD-	Out
7	Rx Clock+	RT+	Out
8	Rx Clock-	RT-	Out

2.9 TMI MODULE CONFIGURATIONS

The following paragraphs describe settings for any of the individual TMI modules that may require jumper or other installation settings on the module.

2.9.1 CRS-370 TMI - HSSI INTERFACE

The jumper J2 on the CRS-370 TMI module selects the functionality of the control signals, CA and TA. An outline drawing of the module is shown in Figure 2-7. Table 2-11explains the jumper settings of J2. The factory ships the module with J2 not installed.

Table 2-11. CRS-370 J2 Jumper Settings

J2 Jumper	Settings
Not Installed (default)	TA to CA loop, (connected)
Installed	TA controls Tx carrier RR controls CA

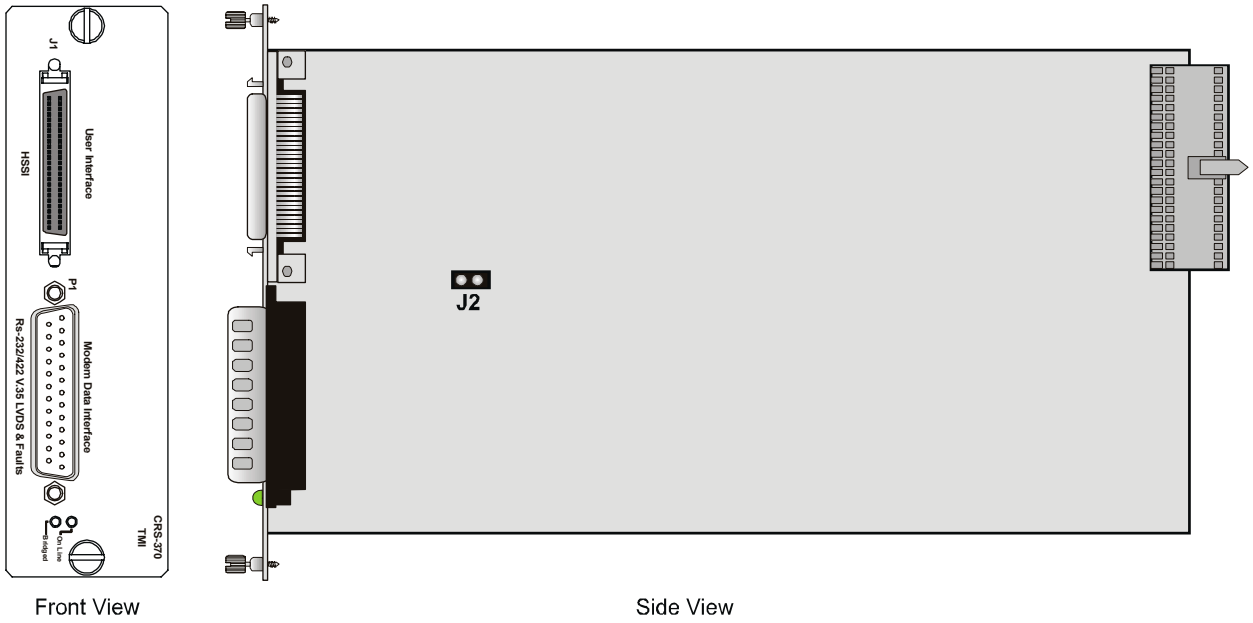
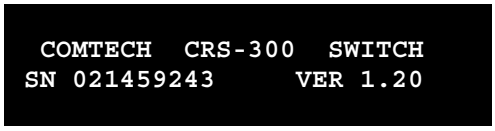


Figure 2-7. CRS-370 HSSI to LVDS Module

Chapter 3. Front Panel Operation

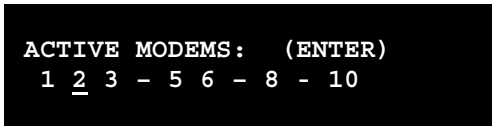
3.1 Front Panel Display

Users can fully control and monitor the CRS-300 from the front panel using the display and keypad. The display has two lines each of 24 characters:



On most menu screens, users see a flashing, solid-block cursor. This indicates the currently selected item, digit, or field:

Where this solid block cursor would obscure the item being edited (for example, a numeric field), the cursor will automatically change to an underline cursor.

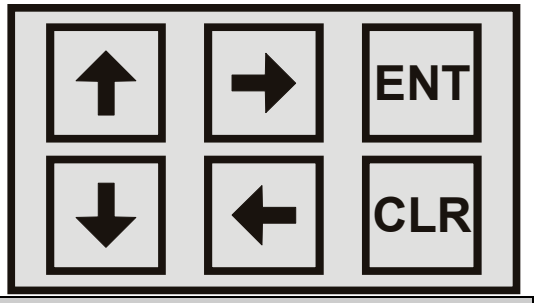


To prevent the display from becoming burnt by a constant image, the unit employs a screen saver feature, which activates after one hour. The top line of the display shows the Switch ID (which can be entered by the user), and the bottom line shows the current status of the Switch followed by the message "Press any key . . ."

The message moves across the screen constantly. Press any key to restore the previous screen.

3.2 FRONT PANEL KEYS

The keypad contains six individual key switches mounted behind a sealed membrane overlay. The keys have a positive "click" action for tactile feedback. These six switches are identified as follows:



Name	Symbol	Function
UP ARROW	↑	Edits the value at the current cursor position, if appropriate. Increments the value of a numeric field.
DOWN ARROW	↓	Edits the value at the current cursor position, if appropriate. Decrements the value of a numeric field.
RIGHT ARROW	→	Moves the cursor to the right, when it is displayed.
LEFT ARROW	←	Moves the cursor to the left, when it is displayed.
ENTER	**ENT**	Accepts an edited entry. Most menus prompt users to press this key by displaying the text (PRESS ENTER), (ENTER) or (ENT). Press ENT to accept the entry and display the previous menu.
CLEAR	**CLR**	Exits the current operation and displays the previous menu without accepting any configuration changes.

IMPORTANT

The keypad has an auto-repeat feature. If a key is held down for more than 1 second, the key action will repeat, automatically, at the rate of 15 keystrokes per second. This is particularly useful when editing numeric fields.

3.3 LED INDICATORS

Table 3-1 describes the three LEDs at the top left of the front panel. These LEDs reflect the condition of the Switch itself.

Table 3-1. Switch LED Indicators

LED	Color	Condition
UNIT STATUS	**Red**	A Switch Fault exists. Example: PSU fault or COMMS failure
	Green	No Switch Faults
STORED EVENT	**Off**	No Stored Events
	Orange	Stored Events exist for the Switch.
	Orange (Flashing)	CAUTION, Switch is in Manual mode.
REMOTE	**Off**	Switch is in Local Mode. Remote monitoring is possible, remote configuration control is not allowed.
	Orange	Switch is in Remote Mode. Configuration changes are disabled via the front panel keypad

The front panel contains six LEDs (Status, Transmit Prompt, Receive Prompt, Deferred, On Line, Bridge) for each Traffic Modem connected to the rear of the Switch, and two LEDs (Fault, On Line) each for the Redundant Modem. All of these LEDs are described in **Table 3-2**.

Table 3-2. Transmit and Receive Traffic Modem LED Indicators

LED	Color	Condition
UNIT STATUS	**Red**	A Unit Fault exists
	Orange	No Unit Faults, but a Traffic Fault exists or the TMI is not plugged in.
	Green	No Unit Faults or Traffic Faults
TRANSMIT PROMPT	**Green**	No Tx Traffic Faults
	OFF	A Tx Traffic Fault exists or the TMI is not plugged in
RECEIVE PROMPT	**Green**	No Rx Traffic Fault exists
	OFF	A Rx Traffic Fault exists or the TMI is not plugged in
DEFERRED	**Orange**	Deferred Maintenance Alarm exists on this modem.
	OFF	
ONLINE	**Green**	The Unit is Online and carrying traffic
	OFF	The Unit is Offline (Standby) – forced by the Switch
BRIDGED	**Orange**	Modem is currently being Bridged by Redundant Modem
	Off	Modem is not being Bridged

3.4 MENU TREE

Figure 3-1 shows the menu structure of the CRS-300. The detailed screens and menus are described individually.

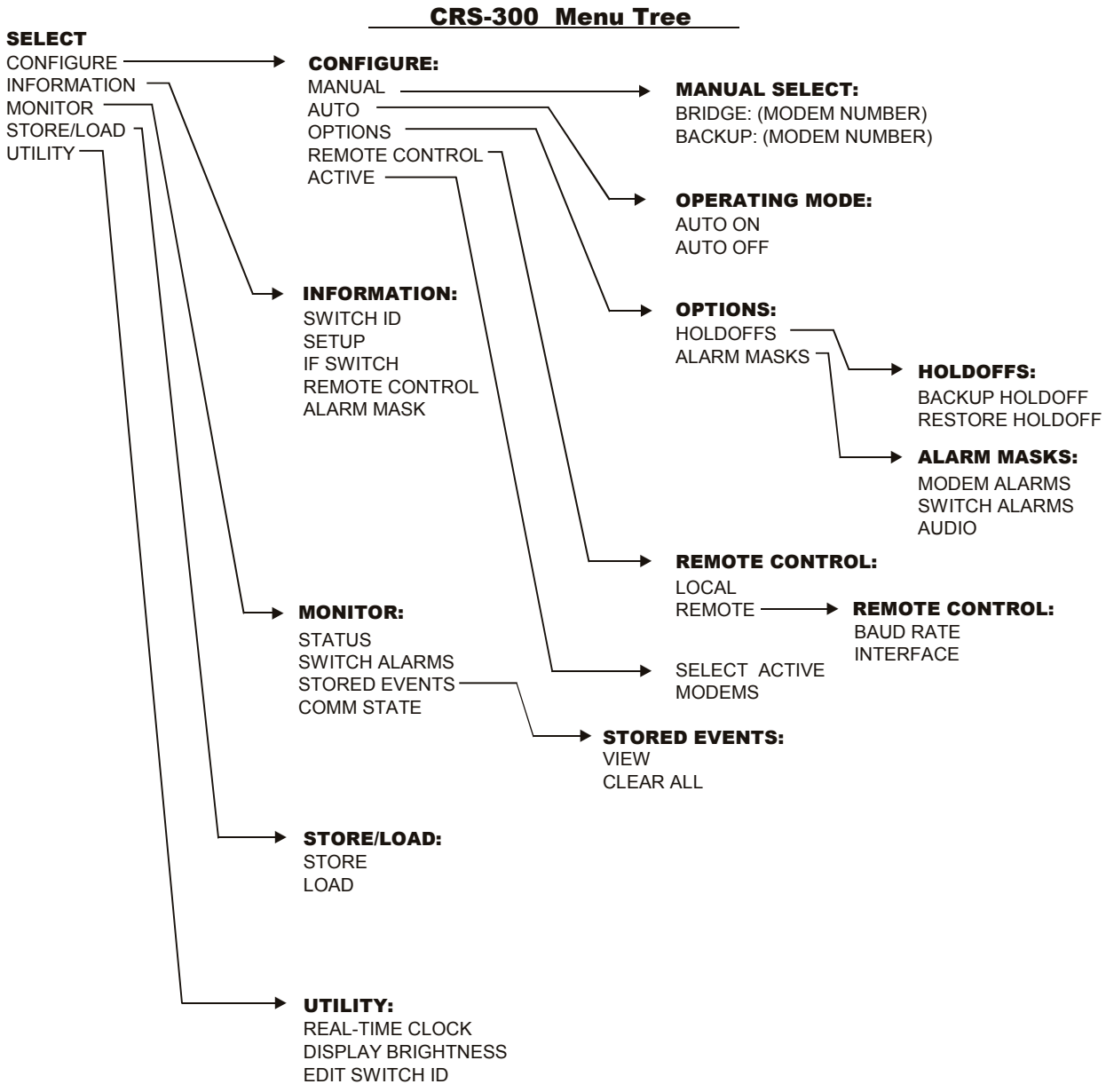


Figure 3-1. Menu Trees

3.4.1 OPENING SCREEN

This screen is displayed whenever power is first applied to the unit. Pressing any key will take the user to the top-level selection screen.

3.4.2 SELECT

The user is presented with the following choices:

Selection	Description
CONFIG (Configuration)	This menu branch permits the user to fully configure the Switch.
INFO (Information)	This menu branch permits the user to view information on the Switch, without having to go into configuration screens.
MONITOR	This menu branch permits the user to monitor the status of the Switch and view the log of stored events for both the Switch and its attached modems.
STORE/LD (Store/Load)	This menu branch permits the user to store and to retrieve up to 10 different Switch configurations.
UTIL (Utility)	This menu branch permits the user to perform miscellaneous functions, such as setting the Real-time clock, adjusting the display brightness, etc.

3.4.3 CONFIG

```
CONFIG:  MANUAL  AUTO[OFF]
 OPTIONS  REMOTE  ACTIVE
```

The sub-branches available are:

Branch	Function
MANUAL	This menu sub-branch permits the user to select which Traffic Modem the Switch should bridge or backup.
AUTO[ON] AUTO[OFF]	This menu sub-branch permits the user to turn auto mode off or on. The currently selected state is always shown on this menu
OPTIONS	This menu sub-branch permits the user to set several operating parameters of the Switch that pertain to enabling or disabling the availability of Traffic Modems, the reporting of faults and time delays for responding to faults.
REMOTE	This menu sub-branch permits the user to define the remote control settings.
ACTIVE	Permits the user to activate modems, if a TMI is present.

IMPORTANT

The Switch may be monitored over the remote control bus at any time. When in Local mode, however, configuration parameters may only be changed through the front panel. Conversely, when in Remote mode, the unit may be monitored from the front panel, but configuration parameters via may only be changed remote control bus.

3.4.3.1 (CONFIG) MANUAL

```
MANUAL SELECT:
BRIDGE:02   BACKUP:02
```

The user may manually select which Traffic Modem is to be bridged or backed-up. When the Switch is in Manual mode (Auto is OFF), both of these selections are available. Use the LEFT/RIGHT keys to select between Bridge and Backup. Use the UP/DOWN keys to scroll through all active Traffic Modems, skipping inactive modem slots. Press ENTER to configure.

When in Auto mode, the Switch has control, and will automatically back-up any active Traffic Modem, based on its fault relay activity. In this case, the Manual Select screen would appear as shown below.

```
MANUAL SELECT:
BRIDGE:02   BACKUP: AUTO
```

In Auto mode, the BACKUP selection is unavailable for manual selection, but the Modem being *bridged* may be changed. Use the UP/DOWN keys to scroll through all active Traffic Modems, skipping inactive modem slots. Press ENTER to configure.

When the Switch is in Back-up mode, the Redundant Modem is online. In this event, the user may not alter the bridge/back-up state, and a message is shown instead of the menu:

```
MANUAL SELECT:
SWITCH IS IN AUTO MODE
```

Press CLEAR or ENTER to return to the previous menu.

The Switch learns and retains the configuration of all of the active modems in the set-up. This configuration information is used to program the Redundant Modem to match the configuration of the Modem being bridged.

If the Switch is in Back-up and the user selects to come out of Back-up mode, bringing a new modem online, the screen will display:

```
SET MDM USING BU CONFIG?
 NO  YES  (ENTER)
```

Perhaps a new modem is replacing a failed unit. The replacement modem configuration may not be correct. The user can opt for the Switch to use the known link configuration (active in the Redundant Modem) to configure the new Modem. Use the **LEFT/RIGHT** keys to select YES and ENTER. If the modem does not need configuring, then select NO and press ENTER.

3.4.3.2 (CONFIG) AUTO[OFF OR ON]

```
OPERATING MODE:
AUTO-OFF  AUTO-ON (ENTER)
```

The user is prompted to turn Auto to OFF or ON. When OFF (Manual mode), the Switch does not respond automatically to any Modem faults and simply performs whatever manual setting the user performs via the Manual-select previous menu. The STORED EVENT indicator blinks when in Manual mode to alert the user that the Switch is effectively not in use.

3.4.3.3 (CONFIG) OPTIONS

```
OPTIONS:
  HOLDOFFS   ALARM-MASK
```

The user is prompted to select various options concerning how the Switch will react to various faults.

3.4.3.3.1 (CONFIG, OPTIONS) HOLDOFFS

```
BACKUP HOLDOFF SEC:  05
RESTORE HOLDOFF SEC: 10
```

The user is prompted to set the holdoffs, or delay times between the Switch's modem alarm detection and its reaction to the event. These holdoffs are only applicable when the Switch is in Auto mode. When an active modem exhibits an unmasked fault, the Switch bridges it with the Redundant Modem and checks that the latter is not also faulted. If there is no fault, the backup holdoff determines how long the Switch will wait before performing the actual backup, or switchover of traffic to the Redundant Modem.

When the Switch is currently backing up a Traffic Modem, and that offline modem's fault clears, the Switch will continue to back it up unless another active modem becomes faulted. In this case, the restore holdoff is the length of time that the originally faulted modem must stay unfaulted before the Switch will automatically put it back online so that the Redundant Modem is available to bridge the newly faulted modem. Both holdoffs can be set from 2 to 99 seconds.

3.4.3.3.2 (CONFIG, OPTIONS) ALARM-MASK

```
ALARM MASK:  MODEM-ALARMS
SW-ALARMS  AUDIO  (ENTER)
```

The Switch logs and reacts to both its own faults and modem faults. Either type of faults may be masked using this sub-menu. In addition, an audible buzzer can be enabled as an additional indicator.

(CONFIG, OPTIONS, MASK) MODEM ALARMS

```
MODEM ALARM MASK:  NONE
TX  RX  TX+RX    (ENTER)
```

The user is prompted to mask Transmit or Receive Traffic faults (or both) from being reacted to by the Switch. This not only prevents the Switch from performing Auto mode functions when these modem faults are sensed, but also keeps the faults from being logged by the Switch. Note that these selections are global to all the modems. If masking of individual modem faults is desired, it should be done directly on the modem. Unmasked modem faults are logged on active modems only.

(CONFIG, OPTIONS, MASK) SWITCH ALARMS

```
SWITCH ALARM MASK: NONE
↙PSU-A  PSU-B↘  (ENTER)
```

The user is prompted to select which, if either, of the plug-in power supply units should be ignored in case any of their voltage outputs are monitored by the Switch as being out of range. Only one of the units can be masked at a time. Normally this would be done if the user wishes to run with only one supply, or if a bad supply had been removed for service or replacement.

(CONFIG, OPTIONS, MASK) AUDIO

```
AUDIO MASK:  NONE  SW-ALMS
MODEM-ALMS  BOTH   (ENTER)
```

For all Switch or modem alarms that are unmasked, the user may select which alarm types should force the Switch to react with an audible buzzer located behind the front panel. In addition, a relay closure to ground activates on pin 20 of the System Alarms connector so that the user may attach other indicators.

3.4.3.4 (CONFIG) REMOTE

```
SELECT REMOTE CONTROL:
LOCAL REMOTE (PRESS ENT)
```

The user is prompted to select LOCAL or REMOTE using the LEFT/RIGHT arrow keys, then to press ENTER.

3.4.3.4.1 (CONFIG, REMOTE) LOCAL

If LOCAL was selected, remote *control* will be disabled. Remote *monitoring* is always possible.

3.4.3.4.2 (CONFIG, REMOTE) REMOTE

If REMOTE was selected, the following sub-menus will be displayed:

```
REMOTE CONTROL: BAUDRATE
INTERFACE   (PRESS ENTER)
```

The user is prompted to select BAUDRATE or INTERFACE, using the LEFT/RIGHT arrow keys, then to press ENTER.

(CONFIG, REMOTE, REMOTE) BAUDRATE

```
EDIT SWITCH BAUDRATE:
19200 BAUD  (PRESS ENT)
```

If BAUD RATE is selected, the user may select the baud rate of the remote control bus, connected locally to the M&C computer. The value is changed using the UP/DOWN arrow keys. The user should then press ENTER. Values of 300, 1200, 2400, 4800, 9600 and 19200 baud are possible.

Note: this setting does not affect the internal communications between the Switch and the Modems, which is fixed at EIA-232, 9600 baud, 8-N-1.

(CONFIG, REMOTE, REMOTE) INTERFACE

```
ELECT. INTERFACE:  RS232
RS485-2W   RS485-4W (ENT)
```

If INTERFACE was selected, the user may select RS-232, RS-485 (2-wire), or RS-485 (4-wire), using the LEFT/RIGHT arrow keys. After pressing ENTER, the user will be further prompted to enter the bus address.

In EIA-232 mode, the bus address is fixed at 0, and the following screen will be displayed:

(Note: RS is now EIA in the text of this document.)

```
IN RS232 MODE THE BUS
ADDRESS IS FIXED AT 0000
```

If in EIA-485, the address may be selected:

```
EDIT SWITCH BUS ADDRESS:
3000       (PRESS ENTER)
```

The value of the address is changed using the UP/DOWN arrow keys. The user should then press ENTER. The valid addresses are 1000, 3000, 5000 and 7000 only, as explained in the Remote section of this manual.

Note: this setting does not affect the internal communications between the Switch and the Modems, which is fixed at EIA-232, 9600 baud, 8-N-1.

After entering the bus address, the following screen is shown:

```
SELECT DATA FORMAT:
8-N-1   7-E-2   7-O-2
```

Note: this setting does not affect the internal communications between the Switch and the Modems, which is fixed at EIA-232, 9600 baud, 8-N-1.

3.4.3.5 (CONFIG) ACTIVE MODEMS

```
ACTIVE MODEMS: (ENTER)
1 2 3 - 5 6 - 8 9 10
```

The user is prompted to select which Traffic Modems should be activated. A hyphen (-) will appear in place of the modem number if it is de-activated. If a Traffic Modem interface is not plugged into a slot, that position cannot be activated. A modem must be active in order for it to be manually or automatically bridged or backed-up. Once activated, the Switch will expect a Modem to be attached, and will poll the Modem for status information.

3.4.4 INFO (INFORMATION)

```
INFO:  SWITCH-ID   SETUP
IF-SWITCH  REMCONT  MASK
```

The user is prompted to select SWITCH-ID, SETUP, IF-SWITCH, REMCONT or MASK using the LEFT/RIGHT keys, then press ENTER. These screens display information on the current configuration of the Switch without risking inadvertent alterations.

3.4.4.1 (INFO) SWITCH-ID

```
SWITCH ID:
------------------------
```

This displays the user-defined Switch ID string, which is entered via the UTILITY, SWITCH-ID screen. To return to the previous menu, press ENTER or CLEAR.

3.4.4.2 (INFO) SETUP

```
TM:  1 2 3 4 5 - 7 - 9 10
AUTO:OFF  BKUP:05  REST:20
```

The information on this screen reflects some of the settings configured in the CONFIG, OPTIONS menu. Active Traffic Modems are listed on the top line, with Auto mode and the two holdoff times listed on the bottom.

3.4.4.3 (INFO) IF-SWITCH

```
TRANSPONDER SWITCH IS
       ABSENT
```

This screen shows whether a CRS-280 IF Transponder Switch is connected to the CRS-300 1:N Redundancy Switch. When an IF Switch is present, the second line will indicate “PRESENT”, and any offline modem (TM or RM) will not have its Tx IF muted by the CRS-300.

3.4.4.4 (INFO) REMCONT (REMOTE CONTROL INFO)

This screen shows if the unit is in LOCAL or REMOTE mode, and gives details of the electrical interface type, the unit address, the baud rate, and data format. Pressing ENTER takes the user back to the previous menu.

3.4.4.5 (INFO) MASK (ALARM MASK INFO)

This screen shows the alarms that are currently masked. If an alarm is not masked, a blank is displayed in the relevant screen position. Power Supplies A and B cannot be masked at the same time, but are shown together here to indicate their relative positions on the screen.

3.4.5 MONITOR

The user is prompted to select STATUS, SW-ALARM, STORED EVENTS, or COMM-STATE (state of I/O communications with the modems) using the LEFT/RIGHT arrow keys, then to press ENTER.

3.4.5.1 (MONITOR) STATUS

```
TM 02 IS BRIDGED BY RM
BACKUP HOLDOFF: 05 SEC
```

This screen shows the status of the Switch.

When the Redundant Modem is not backing up any of the Traffic Modems, the display will show which TM is currently being bridged by the RM. If Auto mode is on, it will also show the backup holdoff-time should the bridged TM fail. If Auto mode is off, the second line displays "OFF". When the Switch has taken the bridged TM offline and replaced it with the RM (whether done manually or automatically), the screen changes as shown below:

```
TM 02 IS BACKED UP BY RM
RESTORE HOLDOFF:  05 SEC
```

Now, the restore holdoff-time is shown on the second line if Auto mode is on.

3.4.5.2 (MONITOR) SW-ALARM

The following screens show the possible display of the current Switch fault status:

```
SWITCH ALARM:      NONE
```

There are no faults. The unit status LED should be green.

The following are examples of the possible faults that the Switch can indicate. For these, the front panel LED will be red:

```
SWITCH ALARM:   -12V PS-B
       ↘ IS UNDERVOLTAGE
```

Power supply voltages:

Bad power supply	Remove it to get it repaired.	Mask the P/S.
Power supply	Not powered up	Mask the P/S.

```
SWITCH ALARM: RM PROBLEM
          RM I/O TIMEOUT
```

Redundant modem problem:

- Ensure the Redundant Modem is set for correct comms: EIA-232, 9600 baud, 8-N-1.
- Ensure a 25-pin cable is connected between the RMI and the Redundant Modem.
- Ensure the 25-pin cable is OK by swapping it for another.
- Ensure an External EIA-232 cable is **not** connected to the back of the Redundant Modem, e.g. when just completed a firmware upload. This cable loads the bus, and the Switch comms will fail. An external comms cable may **only** be connected to the Switch. Communication to the Modems must be achieved via the Switch, using the addressing scheme detailed in Appendix C.

```
SWITCH ALARM: RM PROBLEM
MGC refused, code:12 TFT
```

Example of Redundant Modem Configuration problem:

- Comms are good to the Redundant Modem, but something within the configuration of the bridged Traffic Modem cannot be configured into the Redundant Modem. Ensure the most capable modem is used for the Redundant, with regard to FAST options and installed options, e.g. Turbo card and firmware version. The code indicates the parameter within the MGC configuration string that is causing the Redundant modem to refuse it. The three-letter instruction code is indicated also to assist decoding the problem parameter.

- For the CDM-600 modems, the code is the hex value of the position of the problem parameter within the MGC configuration code:

00		NO ERROR
01	TFQ	Tx Frequency
09	TDR	Tx Data Rate
12	TFT	Tx FEC Type
13	TRS	Tx Reed Solomon type
14	TCR	Tx FEC Code Rate
15	TMD	Tx Modulation
16	TSI	Tx Spectrum Inversion
17	TSC	Tx Scrambler state
18	TPL	Tx Power Level
1C	AUP	AUPC enable
1D	APP	AUPC parameters
23	TCK	Tx Clock source
24	TXO	Tx Carrier state
25	TIT	Tx Interface Type
26	TTC	Tx Ternary Code
27	TFM	Tx Framing Mode
28	TIP	Tx IF Impedance
29	RFQ	Rx Frequency
31	RDR	Rx Data Rate
3A	RFT	Rx FEC Type
3B	RRS	Rx Reed Solomon type
3C	RCR	Rx FEC Code Rate
3D	RMD	Rx Modulation
3E	RSI	Rx Spectrum Inversion
3F	RDS	Rx DeScrambler state
40	RSW	Rx Sweep Width
42	RCK	Rx Clock source
43	EBA	EbNo Alarm point
47	RBS	Rx Buffer Size
4C	RIT	Rx Interface Type
4D	RTC	Rx Ternary Code
4E	RFM	Rx Framing Mode
4F	RIP	Rx IF Impedance
50	EFM	Unit EDMAC Mode
51	ESA	EDMAC Slave Address
55	TST	Unit Test Mode
56	MSK	Unit Alarm Mask
5C	EFR	External Frequency Reference
5D	SSI	Statistics Sampling Interval
5E	RTE	Rx Terrestrial Alarm Enable
5F	TTA	Tx Terrestrial Alarm Mask
60	ODU	ODU comms Enable
61	TBA	Tx Backward Alarms
65	RBA	Rx Backward Alarms
69	TVL	Tx audio Volume
6D	RVL	Rx audio Volume
71	DTY	Drop Type
72	ITY	Insert Type
73	TET	Tx ESC Type - 64k or 2 audio
74	RET	Rx ESC Type - 64k or 2 audio
75	ITD	Invert Tx Data
76	IRD	Invert Rx Data

- For the CDM-570 modems, the code is the decimal number indicating the parameter within the MGC configuration code:

00		NO ERROR
01	ITF	Interface
02	LBO	T1 Line Build-Out
03	FRM	Framing mode
04	TFQ	Tx Frequency
05	TFT	Tx FEC Type
06	TMD	Tx Modulation
07	TCR	Tx FEC Code Rate
08	TDR	Tx Data Rate
09	TSI	Tx Spectrum Invert
10	TSC	Tx Scrambler state
11	TPL	Tx Power Level
12	TCK	Tx Clock
13	TDI	Tx Data Invert
14	TXO	Tx Carrier State
15	AUP	AUPC enable
16	APP	AUPC parameters
17	WUD	Warm-Up Delay
18	RFQ	Rx Frequency
19	RFT	Rx FEC Type
20	RMD	Rx Modulation
21	RCR	Rx FEC Code Rate
22	RDR	Rx Data Rate
23	RSI	Rx Spectrum Invert
24	RDS	Rx DeScrambler state
25	RDI	Rx Data Invert
26	RSW	Rx Sweep Width
27	EBA	Eb/No Alarm point
28	RBS	Rx Buffer Size/enable
29	ERF	External Reference setting
30	EFM	EDMAC Framing mode
31	ESA	EDMAC Slave Address range
32	TST	Test mode
33	MSK	alarm Masks
34	RTS	Request-To-Send control
35	SSI	Statistics Sample Interval

```
SWITCH ALARM: MODEM COMMS
     PROBLEM, POSITION  2
```

Problem with the I/O communications with a Traffic modem, position indicated:

- Ensure the Traffic Modem is set for correct comms: EIA-232, 9600 baud, 8-N-1.
- Ensure a 25-pin cable is connected between the TMI and the Traffic Modem. If a modem has been removed intentionally, de-activate it on the switch, or else the switch will continue to attempt to monitor it.
- Ensure the 25-pin cable is OK by swapping it for another.
- Ensure an External RS-232 cable is **not** connected to the back of a Traffic Modem, e.g. when just completed a firmware upload. This cable loads the bus, and the Switch comms will fail. An external comms cable may **only** be connected to the Switch. Communication to the modems must be achieved via the Switch, using the addressing scheme detailed in Appendix C.

```
SWITCH ALARM:   TMI:I/F
   MISMATCH, POSITION 2
```

TMI: modem interface type mismatch:

- Ensure the modem interface type is compatible with the TMI being used. The CDM-600s have both TX and RX interface types. The CDM-570s just have one unit interface type. Either edit the modem interface setting(s) or swap the TMI.

3.4.5.3 (MONITOR) STORED EVENTS

```
STORED EVENTS: VIEW
CLEAR ALL (PRESS ENTER)
```

The user is prompted to select VIEW or CLEAR ALL, using the LEFT/RIGHT arrow keys, then to press ENTER.

If the user selects CLEAR ALL, the event log is cleared, and the user is taken directly back to the previous menu. However, if there are faults present on the unit at this time, new log entries will be generated for those faults. Note that, in accordance with international convention, the date is shown in DAY-MONTH-YEAR format.

3.4.5.3.1 (MONITOR, EVENTS) VIEW

```
LOG23: 26/01/00 10:37:32
FT-06 RX ALARM (UP/DN)
```

The user may scroll backwards or forwards through the entries in the event log, using the UP/DOWN arrow keys. Pressing ENTER or CLEAR will take the user back to the previous menu. The event log can store up to 98 events. When a fault (FT) condition occurs, it is time-stamped and put into the log. Similarly, when the fault condition clears (OK), this is also recorded, as shown below:

```
LOG24: 26/01/04 10:37:35
OK-06  RX ALARM  (UP/DN)
```

Next to the FT/OK indicator is a code for the errored unit: the TM slot number (1 through 10), RM (for Redundant Modem) or SW (for the Switch).

3.4.5.4 (MONITOR) COMM-STATE (COMMUNICATIONS STATE)

This screen indicates that the Switch has good monitoring I/O communications with the indicated modems.

```
GOOD COMMS WITH MODEMS:
  1 2 3 - 5 - 7 8 – 10
```

3.4.6 STORE/LD (STORE OR LOAD CONFIGURATION)

```
STORE/LOAD CONFIG:
STORE  LOAD  (PRESS ENTER)
```

The user is prompted to select STORE or LOAD using the LEFT/RIGHT arrow keys, then to press ENTER. These sub-menus permit the user to store or load up to 10 different Switch configurations in its non-volatile memory. These are configurations for the Switch itself, not the modems attached to it.

3.4.6.1 (STORE/LD) STORE

```
STORE CONFIGURATION TO
   LOCATION: 10   (ENTER)
```

The user is prompted to select the location to store the current configuration to, using the UP/DOWN arrow keys, then to press ENTER. Locations 1 through 10 are available. If the selected location does not contain a previously stored configuration, the following screen is displayed:

```
YOUR CONFIGURATION HAS
BEEN STORED!    (ENTER)
```

Pressing ENTER or CLEAR will take the user back to the previous menu. If, however, the selected location contains a previously stored configuration, the following screen is displayed:

```
WARNING!  LOC 10 CONTAINS
DATA!  OVERWRITE?  NO  YES
```

The user is prompted to select NO or YES using the LEFT/RIGHT arrow keys, then to press ENTER. Selecting YES will overwrite the existing configuration at the selected location.

3.4.6.2 (STORE/LD) LOAD

```
LOAD CONFIGURATION FROM
   LOCATION: 10   (ENTER)
```

The user is prompted to select the location to load a configuration from, using the UP/DOWN arrow keys, then to press ENTER. Locations 1 through 10 are available. If the selected location contains valid data, the following screen will be displayed:

```
 THE NEW CONFIGURATION
HAS BEEN LOADED  (ENTER)
```

Pressing ENTER or CLEAR will take the user back to the previous menu. If, however, the selected location does not contain valid data, the following screen will be displayed:

```
WARNING! LOC 10 CONTAINS
NO DATA!         (ENTER)
```

Pressing ENTER or CLEAR will take the user back to the previous menu.

3.4.7 UTIL (UTILITY)

```
UTILITY: SET-RTC   DISPLAY
SWITCH-ID   (PRESS ENTER)
```

The user is prompted to select SET-RTC, DISPLAY, or SWITCH-ID, using the LEFT/RIGHT arrow keys, then to press ENTER. This sub-menu permits the user to select from a number of different utility functions, which are described below:

3.4.7.1 (UTILITY) SET-RTC (SET REAL-TIME CLOCK)

```
EDIT REAL TIME CLOCK:
12:00:00  24/04/00  (ENT)
```

The user is prompted to edit the time and date settings of the real-time clock. This is accomplished by selecting the digit to be edited, using the LEFT/RIGHT arrow keys. The value of the digit is then changed using the UP/DOWN arrow keys.

Note that in accordance with international convention, the date is shown in DAY-MONTH-YEAR format. The user should then press ENTER.

3.4.7.2 (UTILITY) DISPLAY (DISPLAY BRIGHTNESS)

```
EDIT DISPLAY BRIGHTNESS:
100%       (PRESS ENTER)
```

The user is prompted to edit the display brightness, using the UP/DOWN arrow keys. The user should then press ENTER.

3.4.7.3 (UTILITY) SWITCH-ID

```
EDIT SWITCH ID:   (ENTER)
---- THIS IS A TEST ----
```

The user is prompted to edit the Switch ID string, using the LEFT/RIGHT and UP/DOWN arrow keys. Only the bottom line is available (24 characters). The cursor selects the position on the bottom line (LEFT/RIGHT) and the character is then edited (UP/DOWN). The following characters are available:

Space ( ) * + - , . / 0-9 and A-Z.

When the user has composed the string, press ENTER.

3.5 FLASH UPGRADING

The CRS-300 allows for very easy updating of the unit firmware. Instead of physically replacing EPROMs, the CRS-300 uses 'flash memory' technology internally.

This makes software upgrading very simple, and updates can now be obtained via the Internet, E-mail, or on disk. The upgrade can be performed without opening the unit, by simply connecting the Switch to the serial port of a computer.

The cable to connect the PC to the Switch is the same as is used for normal EIA-232 remote control, and comprises 3-wires between 9-pin 'D' type female connectors. This is shown in Appendix A.

New firmware can be obtained via the Internet as follows:

```
Go to: www.comtechefdata.com
Click on:
     downloads
     flash upgrades
     flash firmware data files
     CRS-300
```

The latest two releases of firmware code and the Uploader are available in a ZIP file. The Upload utility is a free software utility, that is designed to run under Windows 95/98/2000® or Windows NT®. The Zip file should be downloaded to the user's computer hard disk, and then unzipped. The utility program is called CCCFlash.exe. The firmware file is called, for example, 300V108.ccc.

The user should connect an RS-232 serial cable (details are in Appendix B and are shown in the cable details box on the Uploader screen) from the computer to the remote control port of the Switch. Run the Upload utility. The user should follow the instructions presented on the screen, and the upload will take place automatically. Following the successful upload process, the Switch will automatically re-start, running the new version of firmware. During this process, the non-volatile RAM, storing the configuration of the Switch, will be erased, so the user is then required to re-enter the desired configuration parameters.

Full on-line help is provided with Flash utility, but if users experience a problem, or have a question, they should contact Comtech EF Data Technical Support.

3.5.3 FLASH UPGRADE HELP

Full on-line help is provided with CCCFLASH.EXE. Please contact Comtech EF Data Customer Support if you have questions, or for additional assistance.

NOTES:

Appendix A. Remote Control

This appendix describes the protocol and message command set for remote monitor and control of the CRS-300 Redundancy Switch.

The electrical interface is either an EIA-485 multi-drop bus (for the control of many devices) or an EIA-232 connection (for the control of a single device), and data is transmitted in asynchronous serial form, using ASCII characters. Control and status information is transmitted in packets, of variable length, in accordance with the structure and protocol defined in later sections.

Note: The Remote Control pin-out is shown in Section 2.8.1.3 for EIA-232 and EIA-485.

A.1 EIA-485

For applications where multiple devices are to be monitored and controlled, a full-duplex (or 4-wire plus ground) EIA-485 is preferred. Half-duplex (2-wire plus ground) EIA-485 is possible, but is not preferred. In full-duplex EIA-485 communication, there are two separate, isolated, independent, differential-mode twisted pairs, each handling serial data in different directions.

It is assumed that a 'controller' device (a PC or dumb terminal) transmits data, in a broadcast mode, via one of the pairs. Many 'target' devices are connected to this pair, that all simultaneously receive data from the controller. The controller is the only device with a line-driver connected to this pair - the target devices only have line-receivers connected.

In the other direction, on the other pair, each target has a tri-state line driver connected, and the controller has a line-receiver connected. All the line drivers are held in high-impedance mode until one (and only one) target transmits back to the controller. Each target has a unique address, and each time the controller transmits, in a framed 'packet' of data, the address of the intended recipient target is included. All of the targets receive the packet, but only one (the intended) will reply. The target enables its output line driver, and transmits its return data packet back to the controller, in the other direction, on the physically separate pair.

EIA-485 (full duplex) summary:

- Two differential pairs - one pair for controller to target, one pair for target to controller.
- Controller-to-target pair has one line driver (controller), and all targets have line-receivers.
- Target-to-controller pair has one line receiver (controller), and all targets have tri-state drivers.

A.2 EIA-232

This is a much simpler configuration in which the controller device is connected directly to the target via a two-wire-plus-ground connection. Controller-to-target data is carried, via EIA-232 electrical levels, on one conductor, and target-to-controller data is carried in the other direction on the other conductor.

A.3 BASIC PROTOCOL

Whether in EIA-232 or EIA-485 mode, all data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. The asynchronous character format may be selected from 8-N-1 (8 data bits, no parity, one stop bit), 7-E-2 (even parity) or 7-O-2 (odd parity). The baud rate may vary between 300 baud and 19,200 baud.

All data is transmitted in framed packets. The controller is assumed a PC or ASCII dumb terminal that is in charge of the process of monitor and control. The controller is the only device that is permitted to initiate, at will, the transmission of data. Targets are only permitted to transmit when they have been specifically instructed to do so by the controller.

All bytes within a packet are printable ASCII characters, less than ASCII code 127. In this context, the Carriage Return and Line Feed characters are considered printable.

All messages from controller to target require a response (with one exception). This will be either to return data that has been requested by the controller, or to acknowledge reception of an instruction to change the configuration of the target. The exception to this is when the controller broadcasts a message (such as Set time/date) using Address 0, when the target is set to EIA-485 mode.

A.4 PACKET STRUCTURE

A.4.1 CONTROLLER-TO-TARGET

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
< ASCII code 60 (1 character)	 (4 characters)	/ ASCII code 47 (1 character)	 (3 characters)	= or ? ASCII codes 61 or 63 (1 character)	 (n characters)	Carriage Return ASCII code 13 (1 character)

Example: <0000/RSH=30[cr]

A.4.2 TARGET-TO-CONTROLLER

Start of Packet	Target Address	Address De-limiter	Instruction Code	Code Qualifier	Optional Arguments	End of Packet
> ASCII code 62 (1 character)	 (4 characters)	/ ASCII code 47 (1 character)	 (3 characters)	=, ?, !, or * ASCII codes 61,63,33 or 42 (1 character)	 (From 0 to n characters)	Carriage Return, Line Feed ASCII codes 13,10 (2 characters)

Example: >0000/BBU=107[cr][lf]

A.4.3 START OF PACKET

Controller to Target: This is the character '<' (ASCII code 60)

Target to Controller: This is the character '>' (ASCII code 62)

Because this is used to provide a reliable indication of the start of packet, these two characters may not appear anywhere else within the body of the message.

A.4.4 ADDRESS

While up to 9,999 devices can be uniquely addressed, connection to the 1:N Redundancy Switch imposes some basic limitations.

In EIA-**232** applications, the Switch address is fixed at 0000.

In EIA-**485** applications, the Switch may be set to an address of 1000, 3000, 5000 or 7000. This allows up to 4 Switches to be connected on the same bus.

The 11 modems that may be connected to the Switch may be accessed for remote monitor & control through the Switch via *virtual* addresses. The details of this addressing scheme is shown in Appendix C. Valid remote commands and queries that can be sent to the modems via the Switch depend upon the Modem protocol and the installed options. Please consult the appropriate Modem manual for further information.

Note that in despite the Switch comms being set up for either EIA-232 or EIA-485 mode, the internal link between the Switch and the Modems is always fixed at EIA-232, 9600 baud, 8-N-1. Each modem must be configured for EIA-232 control via its front panel.

1. **The controller sends a packet with the address of a target - the destination of the packet. When the target responds, the address used is the same address, to indicate to the controller the source of the packet. The controller does not have its own address.**
2. **CEFD's SatMac software (Version 3.6 or higher) can monitor and control a CRS-300 Redundancy system. The address scheme details are shown in Appendix C.**

There are also address restrictions for distant-end modems (being accessed by EDMAC) and Comtech transceivers, connected either locally or at the distant-end of a link. See Appendix C for detailed addressing information and diagrams.

A.4.5 INSTRUCTION CODE

This is a three-character alphabetic sequence that identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance. For example, BKH is for BacKup Hold-off time, SID is for Switch ID, etc. This aids in the readability of the message if seen in its raw ASCII form. Only upper case alphabetic characters may be used (A-Z, ASCII codes 65 - 90).

A.4.6 INSTRUCTION CODE QUALIFIER

This single character further qualifies the preceding instruction code. Code Qualifiers obey the following rules:

1. From Controller to Target, the only permitted values are:

   = (ASCII code 61)

   ? (ASCII code 63)

   They have these meanings:

   The = code (controller to target) is used as the assignment operator, and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument(s) that follow it. For example, in a message from controller to target, **BKH=12** would mean 'set the BacK-up Hold-Off time to 12 seconds.'

   The '?' code (controller to target) is used as the query operator, and is used to indicate that the target should return the current value of the parameter defined by the preceding byte. For example, in a message from controller to target, **BKH?** means 'what is the current value of BacK-up Hold-Off time?'

2. From Target to Controller, the only permitted values are:

   = (ASCII code 61)

   ? (ASCII code 63)

   ! (ASCII code 33)

   ***(ASCII code 42)

They have these meanings:

The = code (target to controller) is used in two ways:

First, if the controller has sent a query code to a target (for example: **BKH?** meaning 'what is the BacK-up Hold-Off time?'), the target would respond with **BKH=xx**, where xx represents the time in question.

Second, if the controller sends an instruction to set a parameter to a particular value, then, providing the value sent in the argument is valid, the target will acknowledge the message by replying with **BKH=** (with no message arguments).

The **?** code (target to controller) is only used as follows:

If the controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is not valid, the target will acknowledge the message by replying (for example) with **BKH?** (without message arguments). This indicates that there was an error in the argument of the message sent by the controller.

The ***** code (target to controller) is only used as follows:

If the controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is valid, **but** the modem will not permit that particular parameter to be changed at that time, the target will acknowledge the message by replying (for example) with **BKH*** (with no message arguments).

The **!** code (target to controller) is only used as follows:

If the controller sends an instruction code that the target does not recognize, the target will acknowledge the message by echoing the invalid instruction, followed by the ! character with. Example: **XYZ!**

A.4.7 MESSAGE ARGUMENTS

Arguments are not required for all messages. Arguments are ASCII codes for the characters 0 to 9 (ASCII 48 to 57), A to Z (ASCII 65 to 90), period (ASCII 46) and comma (ASCII 44).

A.4.8 END OF PACKET

Controller to Target: This is the 'Carriage Return' character (ASCII code 13)

Target to Controller: This is the two-character sequence 'Carriage Return', 'Line Feed'. (ASCII code 13, and code 10).

Both indicate the valid termination of a packet.

A.5 REMOTE COMMANDS

AAM=, A-10
AAM?, A-10
ACT=, A-9
ACT?, A-9
AMQ?, A-9

BBU=, A-9
BBU?A-9
BKH=, A-10
BKH?, A-10

CAE=, A-13
CLD=, A-12
CST=, A-11
CST?n, A-11

DAY=, A-14
DAY?, A-14

EID?, A-14

FLT?, A-15

LRS=, A-9
LRS?, A-9

MAM=, A-10
MAM?, A-10
MOD? A-14

NUE?, A-12

OPM=, A-9
OPM?, A-9

RNE?, A-13
RSH=, A-10
RSH?, A-10

SAM=, A-10
SAM?, A-10
SGC=, A-11
SGC?, A-11
SID=, A-11
SID?, A-11
SNO?,A-14
SWR?, A-14

TIM=, A-14
TIM?, A-14

XMI, A-15

NOTES:

Parameter Type	Command (Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Code and qualifier)	Response to query (target to controller)
Local/ Remote Status	LRS=	1 byte, value of 0 or 1	Command or query. x indicates the local/remote status of the Switch: 0 = local 1= remote	LRS= (message OK) LRS? (received OK, but invalid arguments found)	LRS?	LRS=x (see description of arguments)
Operating Mode	OPM=	1 byte, numerical	Command or Query. x indicates the operating mode, where: 0 = manual mode 1 = auto mode	OPM= (message OK) OPM? (received OK, but invalid arguments) OPM* (message OK, but not permitted in current mode)	OPM?	OPM=x (see description of arguments)
Bridged or Backed-up Modem Number	BBU=	3 bytes, numerical	Command or Query. The bridge/back-up state, followed by the selected TM to be acted on: x is: 0 = bridge, 1 = back-up (this can only be set to 1 when in manual mode) yy is 01-10 for selected TM	BBU= (message OK) BBU? (received OK, but invalid arguments) BBU* (message OK, but not permitted in current mode)	BBU?	BBU=xyy (see description of arguments)
Active Modems	ACT=	10 bytes, numerical	Command or Query. The active state of all 10 Traffic Modems: 0 = de-activate Traffic Modem 1 = activate Traffic Modem	ACT= (message OK) ACT? (received OK, but invalid arguments) ACT* (message OK, but not permitted in current mode)	ACT?	ACT=xxxxxxxxxx (see description of arguments)
Active Modem Query	N/A	10 bytes, numerical	Query only. Indicates the state of all 10 Traffic Modems 0 = TMI not present. Modem cannot be activated. 1 = TMI present, but modem not activated. 2 = TMI present, modem activated and responding. 3 = TMI present, modem activated but not responding.	N/A	AMQ?	AMQ=xxxxxxxxxx (see description of arguments)

Parameter Type	Command (Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Code and qualifier)	Response to query (target to controller)
Backup Holdoff Time	BKH=	2 bytes, numerical	Command or Query. The backup holdoff time is the delay when auto mode prepares to backup a faulted modem: 02-99 = # of seconds delay after Redundant Modem has acquired Traffic Modem's configuration before online swap actually takes place.	BKH= (message OK) BKH? (received OK, but invalid arguments) BKH* (message OK, but not permitted in current mode)	BKH?	BKH=xx (see description of arguments)
Restore Holdoff Time	RSH=	2 bytes, numerical	Command or Query. The restore holdoff time is the delay when auto mode prepares to return a modem (previously faulted, now good) back online due to a different Traffic Modem's failure: 02-99 = # of seconds after offline Traffic Modem lost its fault before it is put back online so that Redundant Modem can bridge the newly faulted modem.	RSH= (message OK) RSH? (received OK, but invalid arguments found) RSH* (message OK, not permitted in current mode)	RSH?	RSH=xx (see description of arguments)
Modem Alarm Mask	MAM=	1 byte, numerical	Command or Query. x indicates the Modem alarm mask: 0 = no faults masked 1 = Tx faults masked 2 = Rx faults masked 3 = Both Tx and Rx faults masked	MAM= (message OK) MAM? (received OK, but invalid arguments found) MAM* (message OK, but not permitted in current mode)	MAM?	MAM=x (see description of arguments)
Switch Alarm Mask	SAM=	1 byte, numerical	Command or Query. x indicates the Switch alarm mask: 0 = no faults masked 1 = PSU-A faults masked 2 = PSU-B faults masked	SAM= (message OK) SAM? (received OK, but invalid arguments found) SAM* (message OK, but not permitted in current mode)	SAM?	SAM=x (see description of arguments)
Audio Alarm Mask	AAM=	1 byte, numerical	Command or Query. x indicates the Audio alarm mask: 0 = no faults masked (audio enabled in response to any fault) 1 = Switch faults masked 2 = Modem faults masked 3 = All faults masked (audio never enabled)	AAM= (message OK) AAM? (received OK, but invalid arguments found) AAM* (message OK, but not permitted in current mode)	AAM?	AAM=x (see description of arguments)

Parameter Type	Command (Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Code and qualifier)	Response to query (target to controller)
Switch ID	SID=	24 bytes, ASCII	Command or Query. A user-defined Switch ID, which is a fixed length of 24 characters. Valid characters include: Space ( ) * + - , . / 0-9 and A-Z.	SID= (message OK) SID? (received OK, but invalid arguments found) SID* (message OK, but not permitted in current mode)	SID?	SID=xxxxxxxxxxxxxxxxxxxxxxx (see description of arguments)
Switch Global Configuration	SGC=	29 bytes, numerical	Command or Query. Global configuration of the Switch, in the form: OaaaaaaaaaaBNNbbrrMSAsssssss, where: O = Operating Mode – same as OPM (1 bytes) a = Active Modems – same as ACT (10 bytes) B = Bridge/Backup State – same as BBU (1 byte) N = Selected TM Number - same as BBU (2 bytes) b = Backup Holdoff Time – same as BKH (2 byte) r = Restore Holdoff Time – same as RSH (2 byte) M = Modem Alarm Mask – same as MAM (1 byte) S = Switch Alarm Mask – same as SAM (1 byte) A = Audio Alarm Mask – same as AAM (1 bytes) s = 8 spare bytes	SGC= (message OK) SGC? (received OK, but invalid arguments found) SGC* (message OK, but not permitted in current mode)	SGC?	SGC=OaaaaaaaaaaBNNbbrrMSAsssssss (see description of arguments)
Config Store	CST=	1 byte, numerical, 0 to 9	Command or query. The command forces the Switch to store the its current configuration in Configuration Memory location defined by the argument (0 to 9). Example: CST=4 (Store current configuration in location 4) WARNING: Use with caution! If the location already contains data, it will be automatically overwritten. If in doubt, query the location first. The query returns the contents of the location.	CST= (message OK) CST? (received OK, but invalid arguments found) CST* (message OK, but not permitted in current mode)	CST?n where n is 0 to 9	Returns the same format as the SGC, with the form: CST=xxx....xxx for a valid config, and CST* where no valid config is found

Parameter Type	Command (Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Code and qualifier)	Response to query (target to controller)
Config Load	CLD=	1 byte, numerical, 0 to 9	Command only. Forces the Switch to retrieve the Configuration Memory location defined by the argument (0 to 9) and to re-program the Switch with that stored configuration.	CLD= (message OK) CLD? (received OK, but invalid arguments found) CLD* (message OK, but the memory location does not contain configuration info)	N/A	N/A
Number of Unread Stored Events	N/A	2 bytes, numerical	Query only. Switch returns the number of Stored Events, which remain unread. Note: This means unread over the remote control. Viewing the stored events from the front panel of the modem does not affect this value. Example: NUE=98	N/A	NUE?	NUE=xx (see description of arguments)

Parameter Type	Command (Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Code and qualifier)	Response to query (target to controller)
Retrieve Next 5 unread Stored Events	N/A	80 bytes	Query only. Switch returns the oldest 5 Stored Events, which have not yet been read over the remote control. Reply format: [cr]Sub-body[cr]Sub-body[cr]Sub-body[cr]Sub-body[cr]Sub-body, where Sub-body = K is the fault/clear indicator, where F = Fault, C = Clear, I = Info L is the faulting/clearing unit, values: 1,2,...9,A,B,C,D indicating modems 1,2...9,A=modem 10, B=RM, C=Switch, D=Info M being the fault code, where the value depends on faulting unit: Switch codes are 1 to F, indicating the **position** of the fault within the FLT string. Modem codes are: 1= Unit, 2= Rx traffic, 3= Tx traffic Info codes are: 0= Power off, 1= Power on, 2= Log cleared ddmmyy is the date of the event (international format). hhmmss is the time of the event. If there are no new events, the unit replies with RNE*. If fewer than 5 events remain, the last positions are filled with zeroes.	N/A	RNE?	RNE=[cr]KLMddmmyyhhmmss[cr]KLMddmmyyhhmmss[cr]KLMddmmyyhhmmss[cr]KLMddmmyyhhmmss[cr]KLMddmmyyhhmmss (see description of arguments)
Clear All Stored Events	CAE=	None	Command only. Instructs the unit to clear all Stored Events. This command takes no arguments.	CAE= (message OK) CAE* (message OK, but not permitted in current mode)	N/A	N/A

Parameter Type	Command (Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Code and qualifier)	Response to query (target to controller)
Date	DAY=	6 bytes, numerical	Command or query. The date, in the form ddmmyy (international date convention), where: dd = day of the month, between 01 and 31, mm = month of the year, between 01 and 12, and yy = year, between 97 and 96 (1997 to 2000, then 2000 to 2096) Example: DAY=240457 would be April 24, 2057.	DAY= (message OK) DAY? (received OK, but invalid arguments) DAY* (message OK, but not permitted in current mode)	DAY?	DAY=ddmmyy (see description of arguments)
Time	TIM=	6 bytes, numerical	Command or query. The time from midnight, in the form hhmmss, where hh = hours, between 00 and 23, mm = minutes, between 00 and 59, and ss = seconds, between 00 and 59 Example: TIM=231259 would be 23 hours, 12 minutes and 59 seconds from midnight.	TIM= (message OK) TIM? (received OK, but invalid arguments) TIM* (message OK, but not permitted in current mode)	TIM?	TIM=hhmmss (see description of arguments)
Serial Number	N/A	9 bytes, numerical	Query only. Unit returns its 9-digit serial number. Example: SNO=176512523	N/A	SNO?	SNO=xxxxxxxxx (see description of arguments)
Software Revision	N/A	4 bytes, numerical	Query only. Unit returns the value of internal software revision installed in the unit, in the form x.xx Example: SWR=1.03 (Ver 1.03)	N/A	SWR?	SWR=x.xx (see description of arguments)
Equipment ID	N/A	4 bytes, alpha-numeric	Query only. Unit returns information concerning the equipment identification. Only a base Switch, “S300” is currently in use.	N/A	EID?	EID=xxxx (see description of arguments)
Modem type	N/A	3 bytes, alpha-numeric	Query only. Unit returns information concerning the model of the Redundant Modem attached: 600 or 570.	N/A	MOD?	MOD=xxx (see description of arguments)

Parameter Type	Command (Code and qualifier)	Arguments for Command or Response to Query	Description of arguments (note that all arguments are ASCII numeric codes, that is, ASCII codes between 48 and 57)	Response to Command (target to controller)	Query (Code and qualifier)	Response to query (target to controller)
TMI/RMI types	N/A	11 Bytes	Query only. x indicates the TMI/RMI type detected in each slot position: 0 = none present, 1 = CRS-320 (older), 2 = CRS-330, 3 = CRS-340 (older), 4 = CRS-340 (newer), 5 = CRS-370 (HSSI), 6 = CRS-320 (newer), 7 = CRS-310, the RMI. Example: XMI=21000000007	N/A	XMI?	XMI=xxxxxxxxxxx (see description of arguments)
Faults and Status	N/A	15 bytes, alpha-numeric	Query only. Unit returns the current fault and status codes for the Switch itself, where: r = Redundant Modem: 0 = OK, 1 = RMI not present, 2 = RM I/O timeout, 3 = RM not in remote mode, 4 = RM is in a test mode Power supply information, values 0 or 1 only. A/a = + 5V PSU-A under/over B/b = +5V PSU-B under/over C/c = +12V PSU-A under/over D/d = +12V PSU-B under/over E/e = -12V PSU-A under/over F/f = -12V PSU-B under/over m is TMI: interface mismatch: 0 = no problem, 1-9, A (for pos 10) indicates the position of a TMI interface mismatch i is modem I/O communications: 0 = no problem, 1-9, A (for pos 10) indicates the position of a modem which has been activated but is not responding.	N/A	FLT?	FLT=rAaBbCcDdEeFfmi (see description of arguments)

NOTES:

Appendix B. Cable Drawings

Figure B-1 shows the cable required for a simple EIA-232 connection between a PC serial port and the CRS-300 remote control port. This cable is needed for Flash upgrading.

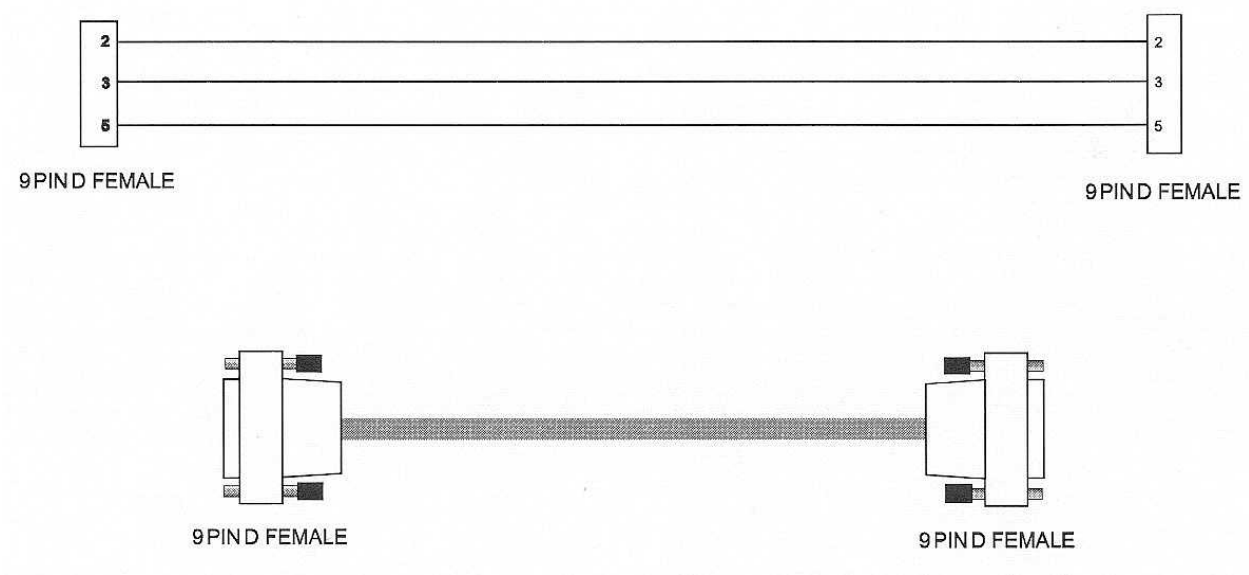


Figure B-1. PC 9-Pin Serial Port to CRS-300 EIA-232 Remote Control Port

Figure B-2 shows the HSSI data cable drawing for connections between the user data and the Switch.

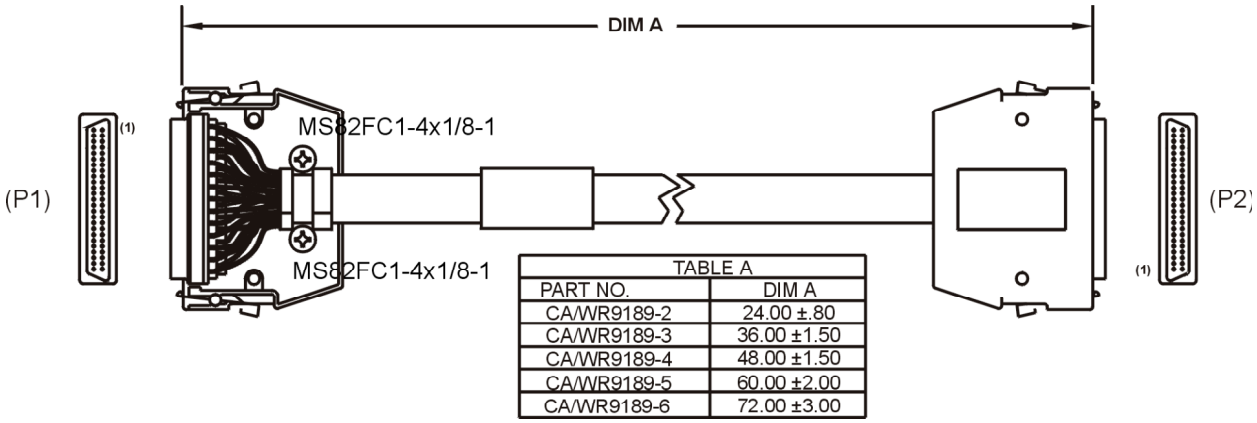


TABLE A	
PART NO.	DIM A
CA/WR9189-2	24.00 ±.80
CA/WR9189-3	36.00 ±1.50
CA/WR9189-4	48.00 ±1.50
CA/WR9189-5	60.00 ±2.00
CA/WR9189-6	72.00 ±3.00

Figure B-2. HSSI Data Cable

For these situations, Figure B-3 show cable drawings for EIA-530 to EIA-422/449 DCE conversion.

Note: The EIA-530 standard pinout (provided on the CRS-300) is becoming more popular in many applications. However, there are still many occasions when, especially for existing EIA-422/449 and V.35 users, a conversion must be made.

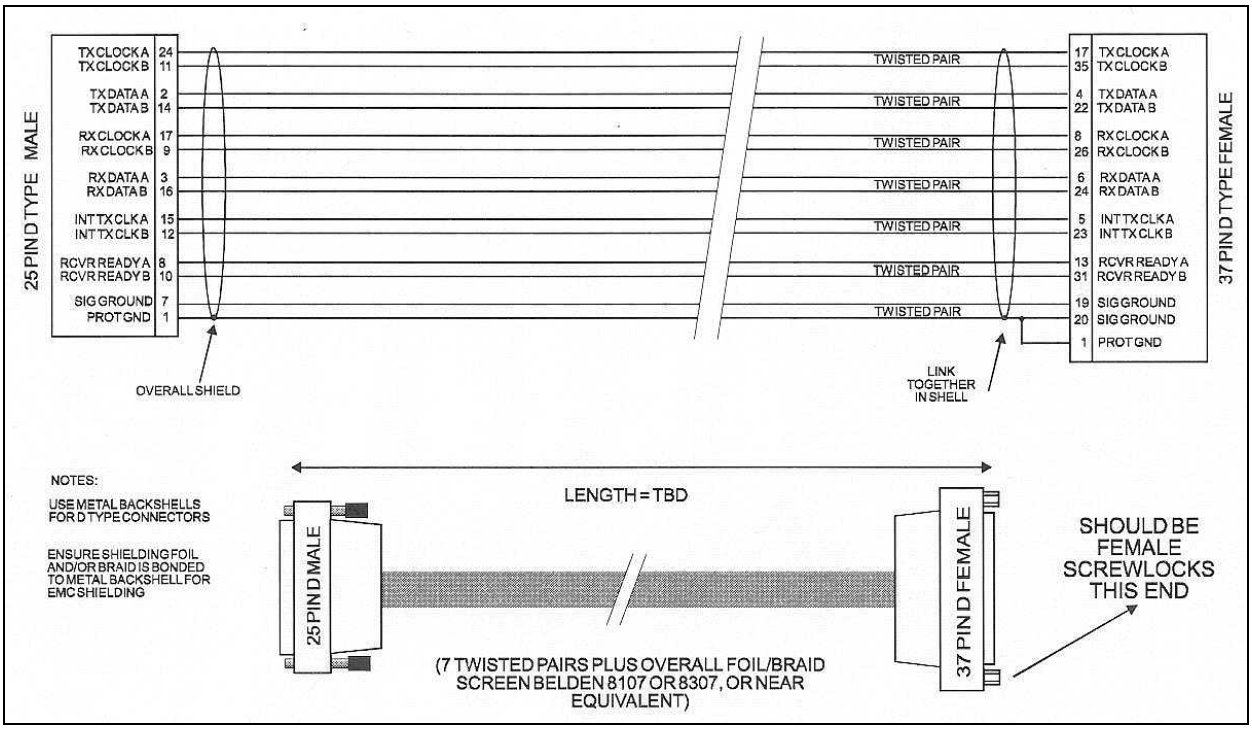

25 PIN D TYPE MALE
TX CLOCK A 24
TX CLOCK B 11
TX DATA A 2
TX DATA B 14
RX CLOCK A 17
RX CLOCK B 9
RX DATA A 3
RX DATA B 16
INT TX CLK A 15
INT TX CLK B 12
RCVR READY A 8
RCVR READY B 10
SIG GROUND 7
PROT GND 1
OVERALL SHIELD
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
LINK TOGETHER IN SHELL
17 TX CLOCK A
35 TX CLOCK B
4 TX DATA A
22 TX DATA B
8 RX CLOCK A
26 RX CLOCK B
6 RX DATA A
24 RX DATA B
5 INT TX CLK A
23 INT TX CLK B
13 RCVR READY A
31 RCVR READY B
19 SIG GROUND
20 SIG GROUND
1 PROT GND
37 PIN D TYPE FEMALE
NOTES:
USE METAL BACKSHELLS FOR D TYPE CONNECTORS
ENSURE SHIELDING FOIL AND/OR BRAID IS BONDED TO METAL BACKSHELL FOR EMC SHIELDING
LENGTH = TBD
25 PIN D MALE
37 PIN D FEMALE
SHOULD BE FEMALE SCREWLOCKS THIS END
(7 TWISTED PAIRS PLUS OVERALL FOIL/BRAID SCREEN BELDEN 8107 OR 8307, OR NEAR EQUIVALENT)

Figure B-3. EIA-530 To EIA-422/449 DCE Conversion Cable

For these situations, Figure B-4 show cable drawings for EIA-530 to V.35 DCE conversion.

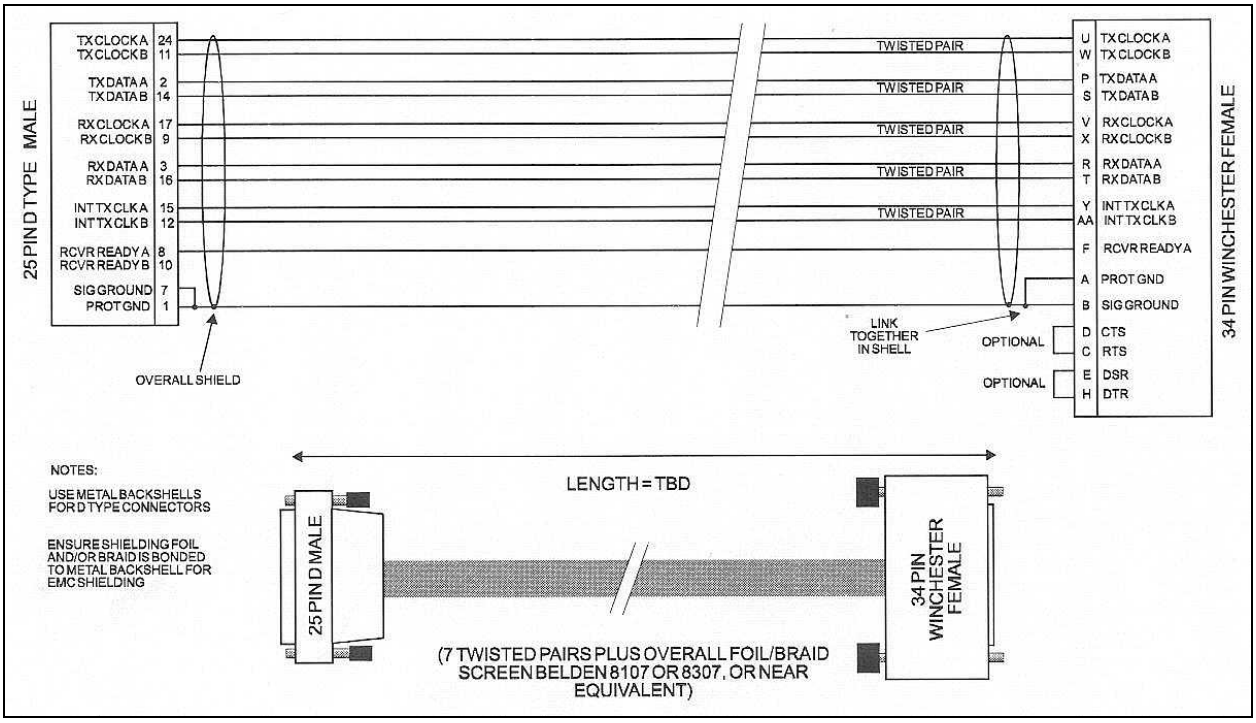


Figure B-4. EIA-530 To V.35 DCE Conversion Cable

Figure B-5 shows the DB-25 data cable required to connect the TMIs and RMI to the modems.

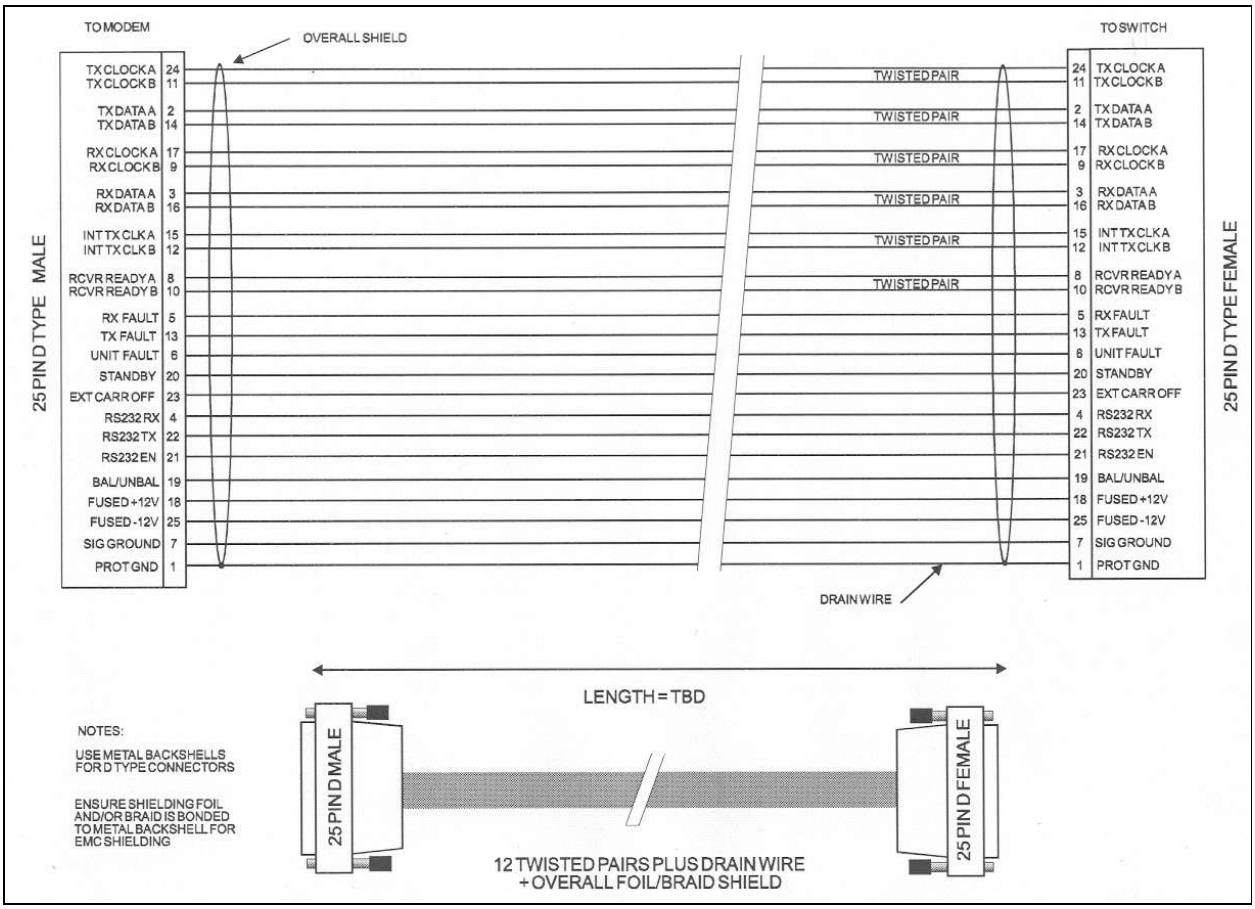
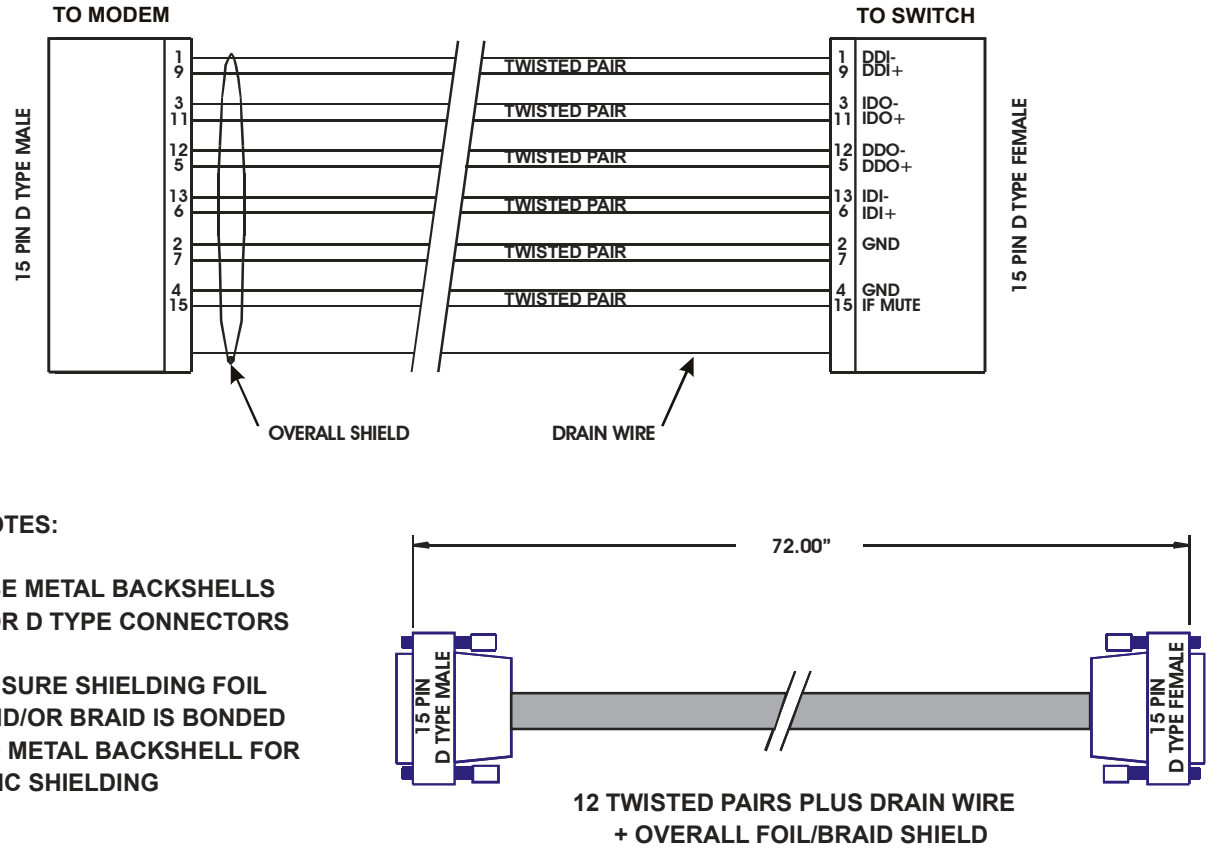


Figure B-5. Switch To Modem Cable, (RS232/422/V.35/LVDS) – 25 PIN 'D' TYPE

Figure B-6 shows the DB-15 data cable required when using G.703, to connect the TMIs and RMI to the modems.



NOTES:

USE METAL BACKSHELLS FOR D TYPE CONNECTORS

ENSURE SHIELDING FOIL AND/OR BRAID IS BONDED TO METAL BACKSHELL FOR EMC SHIELDING

Figure B-6. Switch To Modem Cable, (G.703) – 15 PIN 'D' TYPE

Appendix C. Addressing Scheme Information

C.1 INTRODUCTION

A CRS-300 Switch provides 1:10 redundancy. It is capable of controlling up to 10 Traffic Modems and one Redundant Modem. It uses EIA-232 communication via the 25-pin cables that are connected between each TMI (Traffic Modem Interface) and Traffic modem.

If the modems are configured for EDMAC framing, Monitor & Control (M&C) information may be communicated to the modems and transceivers at the distant-end of the link. In order for an M&C application to be able to communicate with the various devices connected to the Switch, the correct addresses must be used.

This section provides details of the address requirements to allow M&C of the Switch and the various modems and transceivers that may be included in a CRS-300 Redundancy Switch system.

C.2 SWITCH ADDRESS

The permitted Switch remote control addresses are limited.

- **For EIA-485** connections, the only permitted addresses are 1000, 3000, 5000, and 7000.
- **For EIA-232**, the only permitted address is 0000.

Note: Even if the Switch is connected for communications via EIA-485, the connection between Switch and traffic modems remains EIA-232, 9600 baud, and 8N1.

C.3 MODEM & TRANSCEIVER ADDRESSES

To monitor and control modems and transceivers at the distant-end of the communication link, EDMAC must be enabled, via the modem front panel, in local mode. Set the Tx and Rx parameters to establish the link on the modems on each end of the link. Only then may an M&C application be used.

Several abbreviations are going to be used in the following sections and the two diagrams. These are:

MCA Monitor & Control Address, to be entered as the address of a unit into an M&C application, e.g; SatMac

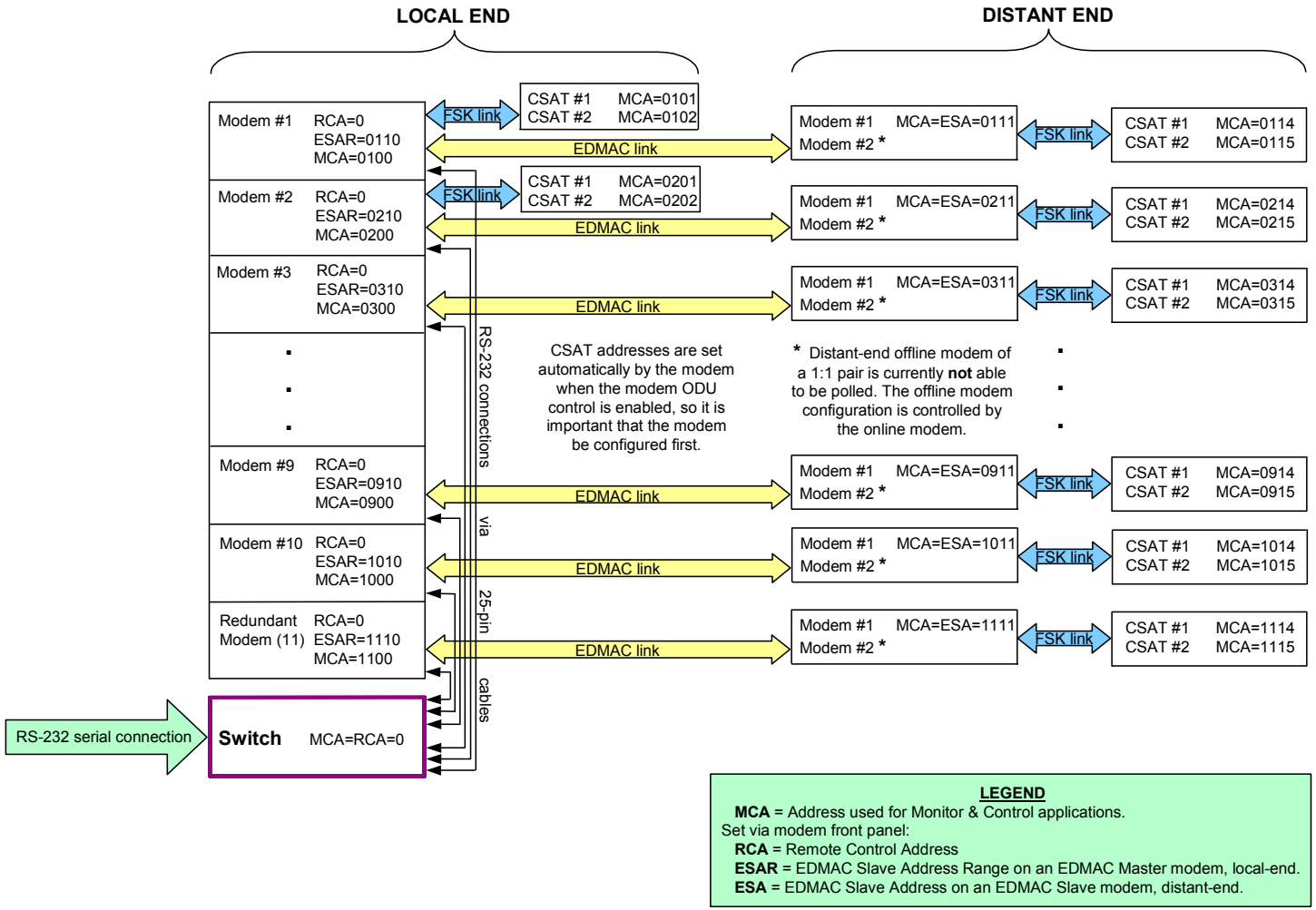
RCA Remote Control Address, to be configured, via the unit front panel (**CONFIG:REMOTE**)

ESAR EDMAC Slave Address Range - a modem must be configured for EDMAC as a Master unit (local-end), with the address provided

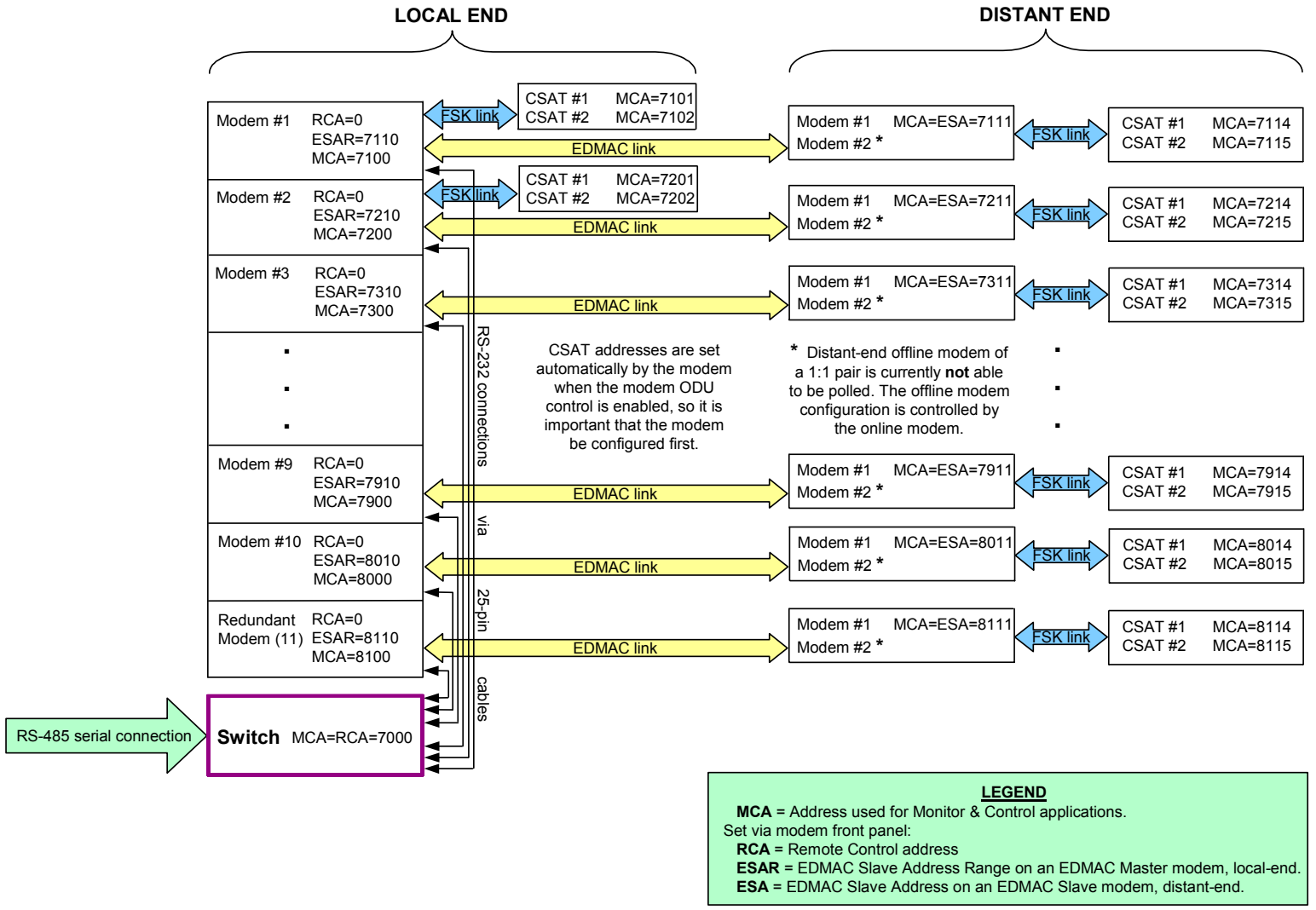
ESA EDMAC Slave Address - a modem must be configured for EDMAC as a Slave unit (distant-end), with the address provided

Note: The following procedures explain the sequence for setting up the modems and transceivers . The addresses are shown using mathematical formulas. A full example of EIA-232 and EIA-485 addressing schemes are also shown in the following diagrams.

CRS-300 Switch EDMAC addressing example, RS-232


LOCAL END
DISTANT END
Modem #1 RCA=0 ESAR=0110 MCA=0100
Modem #2 RCA=0 ESAR=0210 MCA=0200
Modem #3 RCA=0 ESAR=0310 MCA=0300
Modem #9 RCA=0 ESAR=0910 MCA=0900
Modem #10 RCA=0 ESAR=1010 MCA=1000
Redundant Modem (11) RCA=0 ESAR=1110 MCA=1100
Switch MCA=RCA=0
RS-232 serial connection
FSK link
EDMAC link
CSAT #1 MCA=0101
CSAT #2 MCA=0102
CSAT #1 MCA=0201
CSAT #2 MCA=0202
RS-232 connections via 25-pin cables
CSAT addresses are set automatically by the modem when the modem ODU control is enabled, so it is important that the modem be configured first.
Modem #1 MCA=ESA=0111
Modem #2 *
Modem #1 MCA=ESA=0211
Modem #2 *
Modem #1 MCA=ESA=0311
Modem #2 *
Modem #1 MCA=ESA=0911
Modem #2 *
Modem #1 MCA=ESA=1011
Modem #2 *
Modem #1 MCA=ESA=1111
Modem #2 *
CSAT #1 MCA=0114
CSAT #2 MCA=0115
CSAT #1 MCA=0214
CSAT #2 MCA=0215
CSAT #1 MCA=0314
CSAT #2 MCA=0315
CSAT #1 MCA=0914
CSAT #2 MCA=0915
CSAT #1 MCA=1014
CSAT #2 MCA=1015
CSAT #1 MCA=1114
CSAT #2 MCA=1115
* Distant-end offline modem of a 1:1 pair is currently not able to be polled. The offline modem configuration is controlled by the online modem.
LEGEND
MCA = Address used for Monitor & Control applications.
Set via modem front panel:
RCA = Remote Control Address
ESAR = EDMAC Slave Address Range on an EDMAC Master modem, local-end.
ESA = EDMAC Slave Address on an EDMAC Slave modem, distant-end.

CRS-300 Switch EDMAC addressing example, RS-485


LOCAL END
DISTANT END
Modem #1 RCA=0 ESAR=7110 MCA=7100
Modem #2 RCA=0 ESAR=7210 MCA=7200
Modem #3 RCA=0 ESAR=7310 MCA=7300
Modem #9 RCA=0 ESAR=7910 MCA=7900
Modem #10 RCA=0 ESAR=8010 MCA=8000
Redundant Modem (11) RCA=0 ESAR=8110 MCA=8100
Switch MCA=RCA=7000
RS-485 serial connection
FSK link
CSAT #1 MCA=7101
CSAT #2 MCA=7102
CSAT #1 MCA=7201
CSAT #2 MCA=7202
EDMAC link
RS-232 connections via 25-pin cables
CSAT addresses are set automatically by the modem when the modem ODU control is enabled, so it is important that the modem be configured first.
Modem #1 MCA=ESA=7111
Modem #2 *
Modem #1 MCA=ESA=7211
Modem #2 *
Modem #1 MCA=ESA=7311
Modem #2 *
Modem #1 MCA=ESA=7911
Modem #2 *
Modem #1 MCA=ESA=8011
Modem #2 *
Modem #1 MCA=ESA=8111
Modem #2 *
CSAT #1 MCA=7114
CSAT #2 MCA=7115
CSAT #1 MCA=7214
CSAT #2 MCA=7215
CSAT #1 MCA=7314
CSAT #2 MCA=7315
CSAT #1 MCA=7914
CSAT #2 MCA=7915
CSAT #1 MCA=8014
CSAT #2 MCA=8015
CSAT #1 MCA=8114
CSAT #2 MCA=8115
* Distant-end offline modem of a 1:1 pair is currently not able to be polled. The offline modem configuration is controlled by the online modem.
LEGEND
MCA = Address used for Monitor & Control applications.
Set via modem front panel:
RCA = Remote Control address
ESAR = EDMAC Slave Address Range on an EDMAC Master modem, local-end.
ESA = EDMAC Slave Address on an EDMAC Slave modem, distant-end.

C.3.1 SETTING UP MODEMS

Local Modem m, where m is modem position number (1 through 10) on Switch:
MCA = (Switch RCA) + (100 x m)
Set EDMAC Framing on.
Set as EDMAC master.
Set with EDMAC Slave Address Range, ESAR = RCA + 10

Distant Modem 1 (attached to the Distant end of link to Modem m):

Remote control address: no setting required (Remote control not used).

Set EDMAC Framing on.
Set as an EDMAC slave.
Set Slave Address, ESA = ESAR + 1
MCA = ESA

Two Distant Modems in a 1:1 configuration:

Set up the On-line Modem as for Distant Modem 1 (above).

The Offline Modem is automatically configured to match the On-line Modem. M&C can only be achieved to the Online Modem.

Notes:

1. It is not possible for the Offline Modem of a 1:1 pair to respond to EDMAC messages directly as it is not transmitting. Using the internal 1:1 link, the Online Modem polls and retains the **O**ffline **U**nit **S**tatus (**OUS**). This information can be obtained from the **Online Modem,** using the command: **OUS**?
2. This new command is available in firmware versions:
    a. CDM-570 – Firmware version 1.4.1 or subsequent
    b. CDM-570L – Firmware Version 1.3.1 or subsequent
    c. CDM-600 – Firmware Version 1.6.1 or subsequent
    d. CDM-600L – Firmware Version 1.3.0 or subsequent

Refer to the appropriate Modem manual for additional information.

C.3.2 SETTING UP TRANSCEIVERS

Important: Configure the modems first for EDMAC operation, setting up the RCA (Remote Control Address) for local units, and ESAR, ESA (EDMAC addresses) for a EDMAC Modems. A Transceiver's address will be set automatically by its controlling Modem if connected via the FSK link when the ODU enable is configured.

Local Transceiver 1 (linked to Modem m on the Switch):

Set up the Modem Remote Control Address (RCA), first, as shown above.
On the Modem, key to Enable ODU.
Transceiver MCA = Modem RCA + 1.

Local Transceivers 1 & 2 (1:1 configuration, attached to Modem m on the Switch):
Set up the Modem RC Address (RCA), first, as shown above.

On the online Modem, key to Enable ODU. The Modem automatically sets the Transceiver addresses
MCA of Transceiver #1 = Modem RCA + 1
MCA of Transceiver #2 = Modem RCA + 2

Distant Transceiver 1 (stand-alone):

Set up the Modems, first, as shown above.

On the Modem, key to Enable ODU. The Modem automatically sets the Transceiver address.
Transceiver MCA = ESAR + 4 = ESA + 3

Distant Transceivers 1 & 2 (1:1 configuration):
Set up the Modem, first, as shown above.

On the Modem, key to Enable ODU. The Modem automatically sets the Transceiver addresses
MCA of Transceiver #1 = ESAR + 4
MCA of Transceiver #2 = ESAR + 5

C.3.3 M&C APPLICATION

The system is set up such that it may communicated to by an M&C application, e.g; SatMac or CMCS. In the SatMac program, enter the Monitor & Control Addresses (MCA) into the Link Edit Mode screen.

NOTES:

Index

A

Activate The Desired Traffic Modems 2-12
Address A-4
Addressing Scheme
Information C-1
Alarm Masking 2-18
Applying Power To The Switch 2-11
Automatic Mode Operation 2-17

B

Backup Holdoff Operation 2-17
Basic Protocol A-2

C

CABLE DRAWINGS B-1
Compatibility 1-4
CONFIG 3-6
Configuring and Cabling For A Single Transponder 2-13
Configuring and Cabling For Multiple Transponders 2-14
Configuring The IF Carriers 2-13
Configuring The Switch 2-12
Connecting The Cables 2-4
Control Cable for optional CRS-280 and CRS-350 .2-8
Controller-to-target A-3
CRS-300 Connector Pin-outs 2-19
CRS-300 Description 1-6
CRS-350 External User Interface 2-11
CRS-350 to Modem Cables 2-10

D

Description of Assemblies 1-6

E

EIA-232 ..... A-2
EIA-485 ..... A-1
End of Packet A-6
External Data Connection 2-7

F

Flash Upgrading 3-24
Front Panel Display 3-1
Front Panel Keys 3-2
FRONT PANEL OPERATION 3-1

I

INFO (Information) 3-12
Installation 2-1
Installation Details 2-2
Instruction Code Qualifier A-5

L

LED Indicators 3-2

M

M&C Application C-6
Manual Mode Operation 2-17
Menu Tree 3-3
Message Arguments A-6
Modem Data Cables 2-5
Modem & Transceiver Address C-2
MONITOR 3-14

O

OPENING SCREEN 3-5
Optional CRS-280 IF Switch Description 1-10
Optional CRS-350 ESC (ESC) Switch Description 1-11

P

Packet Structure A-3
Physical Cable Requirements 2-4
Provide Airflow 2-2

R

Rack Mounting Instructions 2-2
Redundancy System-Level Block 1-4
REMOTE CONTROL A-1, A-7
Restore Holdoff Operation 2-18

S

Setting Up Modems C-5
Setting Up Transceivers C-5
Specifications 1-12
Start of Packet A-3
STORE/LD (Store or Load Configuration) 3-20
Switch Address C-1
System Requirements) 2-1

T

Target-to-controller A-3
TMI Module Configurations 2-26

U

Unpacking and Inspection 2-1
UTIL (Utility) 3-22

V

Verify Remote COM To Each Active Modem 2-13

NOTES:

METRIC CONVERSIONS

Units of Length

Unit	Centimeter	Inch	Foot	Yard	Mile	Meter	Kilometer	Millimeter
1 centimeter	—	0.3937	0.03281	0.01094	6.214×10^{-6}	0.01	—	—
1 inch	2.540	—	0.08333	0.2778	1.578×10^{-5}	0.254	—	25.4
1 foot	30.480	12.0	—	0.3333	1.893×10^{-4}	0.3048	—	—
1 yard	91.44	36.0	3.0	—	5.679×10^{-4}	0.9144	—	—
1 meter	100.0	39.37	3.281	1.094	6.214×10^{-4}	—	—	—
1 mile	1.609×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	—	1.609×10^{3}	1.609	—
1 mm	—	0.03937	—	—	—	—	—	—
1 kilometer	—	—	—	—	0.621	—	—	—

Temperature Conversions

Unit	° Fahrenheit	° Centigrade
32° Fahrenheit	—	0 (water freezes)
212° Fahrenheit	—	100 (water boils)
-459.6° Fahrenheit	—	273.1 (absolute 0)

Formulas
C = (F - 32) * 0.555
F = (C * 1.8) + 32

Units of Weight

Unit	Gram	Ounce Avoirdupois	Ounce Troy	Pound Avoir.	Pound Troy	Kilogram
1 gram	—	0.03527	0.03215	0.002205	0.002679	0.001
1 oz. avoir.	28.35	—	0.9115	0.0625	0.07595	0.02835
1 oz. troy	31.10	1.097	—	0.06857	0.08333	0.03110
1 lb. avoir.	453.6	16.0	14.58	—	1.215	0.4536
1 lb. Troy	373.2	13.17	12.0	0.8229	—	0.3732
1 kilogram	1.0×10^{3}	35.27	32.15	2.205	2.679	—

2114 WEST 7TH STREET TEMPE ARIZONA 85281 USA
480 • 333 • 2200 PHONE
480 • 333 • 2161 FAX